the tech engineering news

february, 1949

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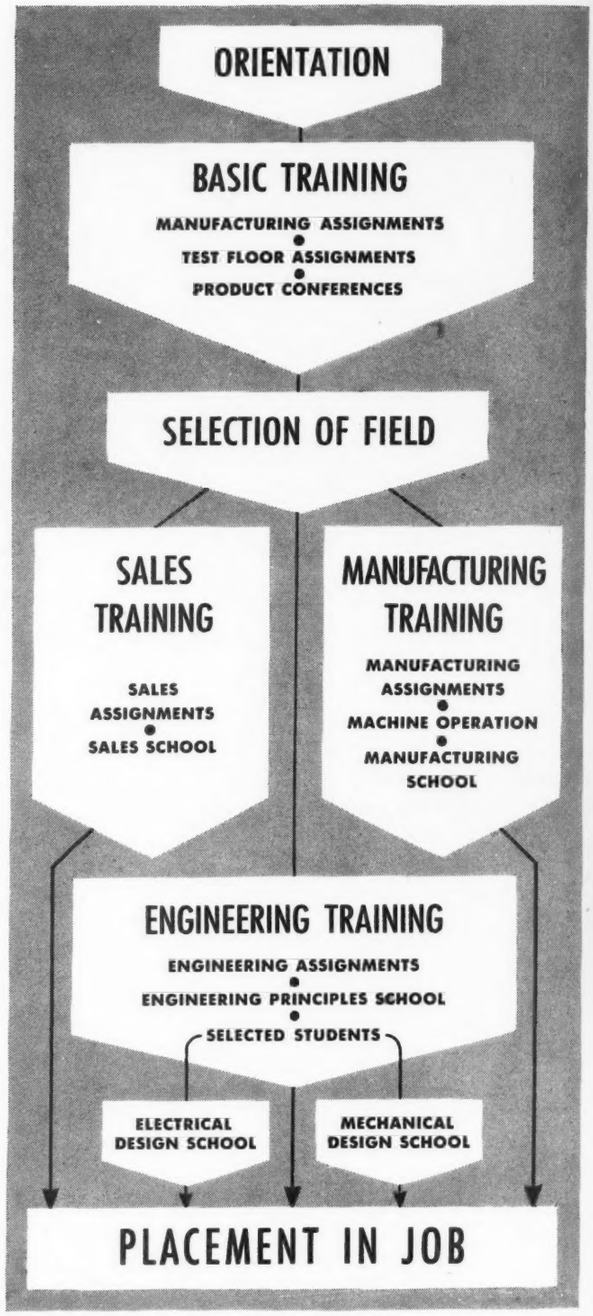

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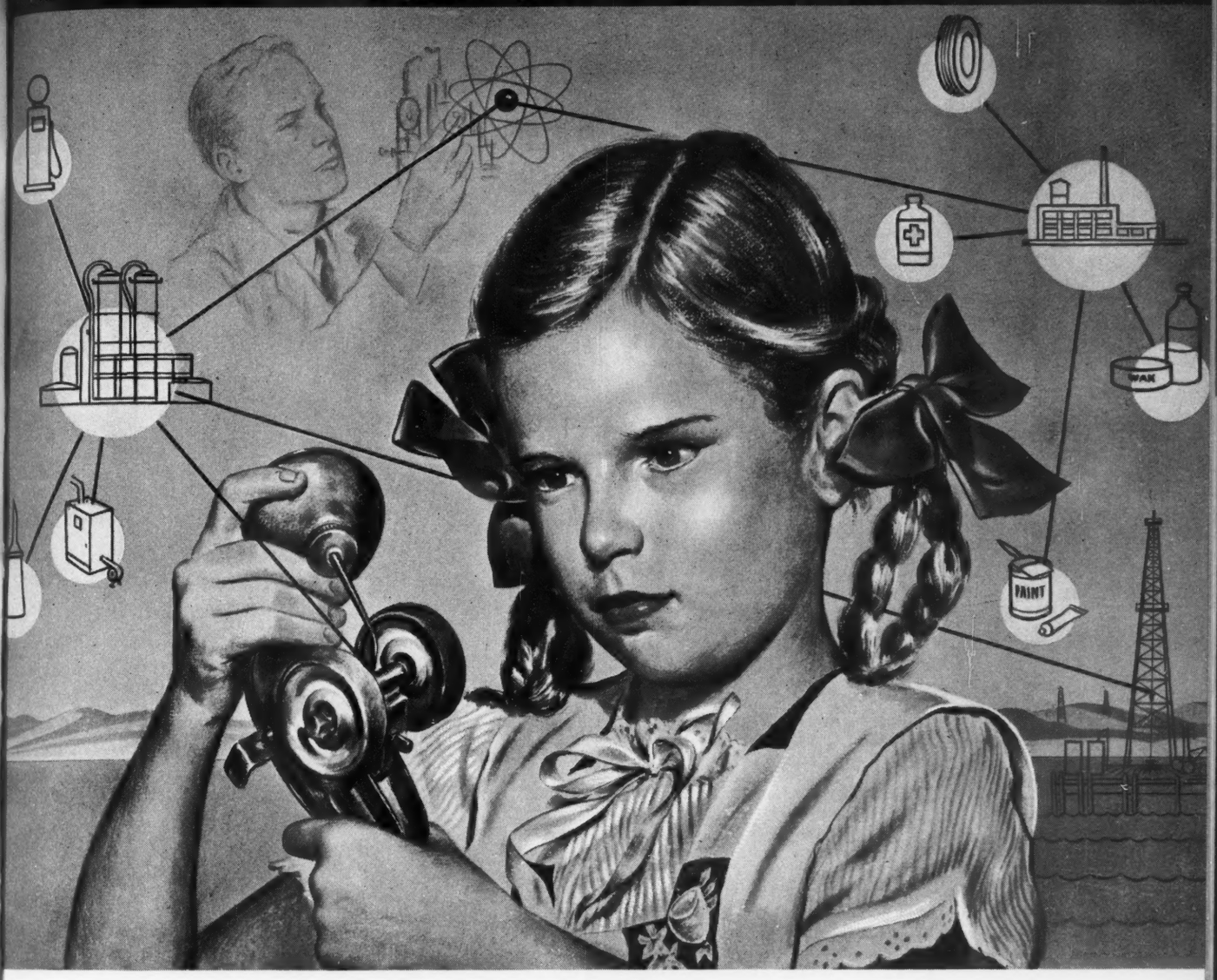

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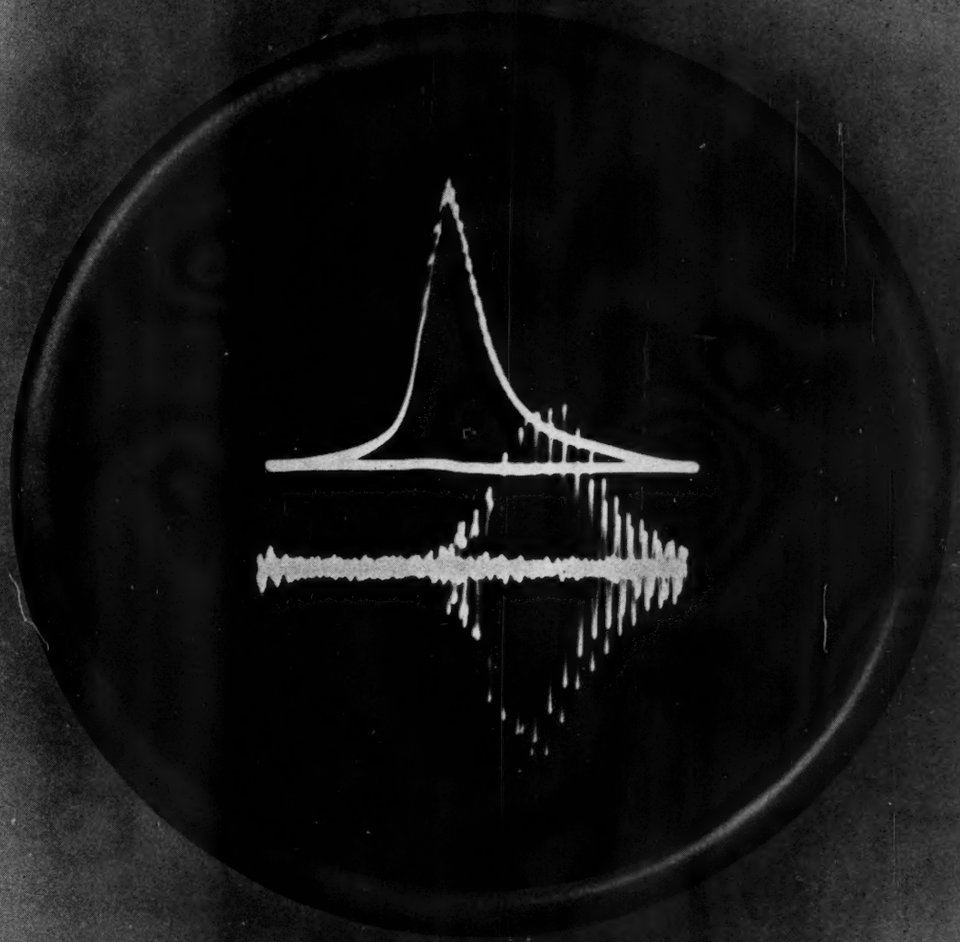

This is a picture of "PING"

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No, this is not the "doodling" of a man on the telephone. Far from it. It's the photographic record of an oscilloscope trace that shows, and-times, detonation in a "knocking" engine. It all happens in a few hundred-thousandths of a second—yet photography gets it clearly and accurately as nothing else can.

Oscillograph recording is but one of countless functional uses of photography in bettering products and improving manufacturing methods. High speed "stills" can freeze fast action at just the crucial moment—and the design or operation of a part can be adjusted to best advantage.

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Such uses of photography—and many more—can help you improve your product, your tools, your production methods. For every day, functional photography is proving a valuable and important adjunct in more and more modern enterprises.

Eastman Kodak Company, Rochester 4, N. Y.

Functional Photography . . . is advancing industrial technics

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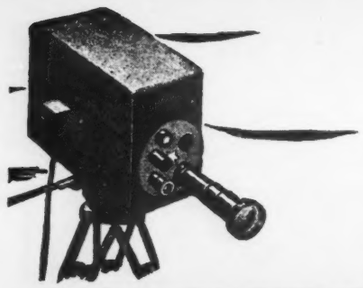

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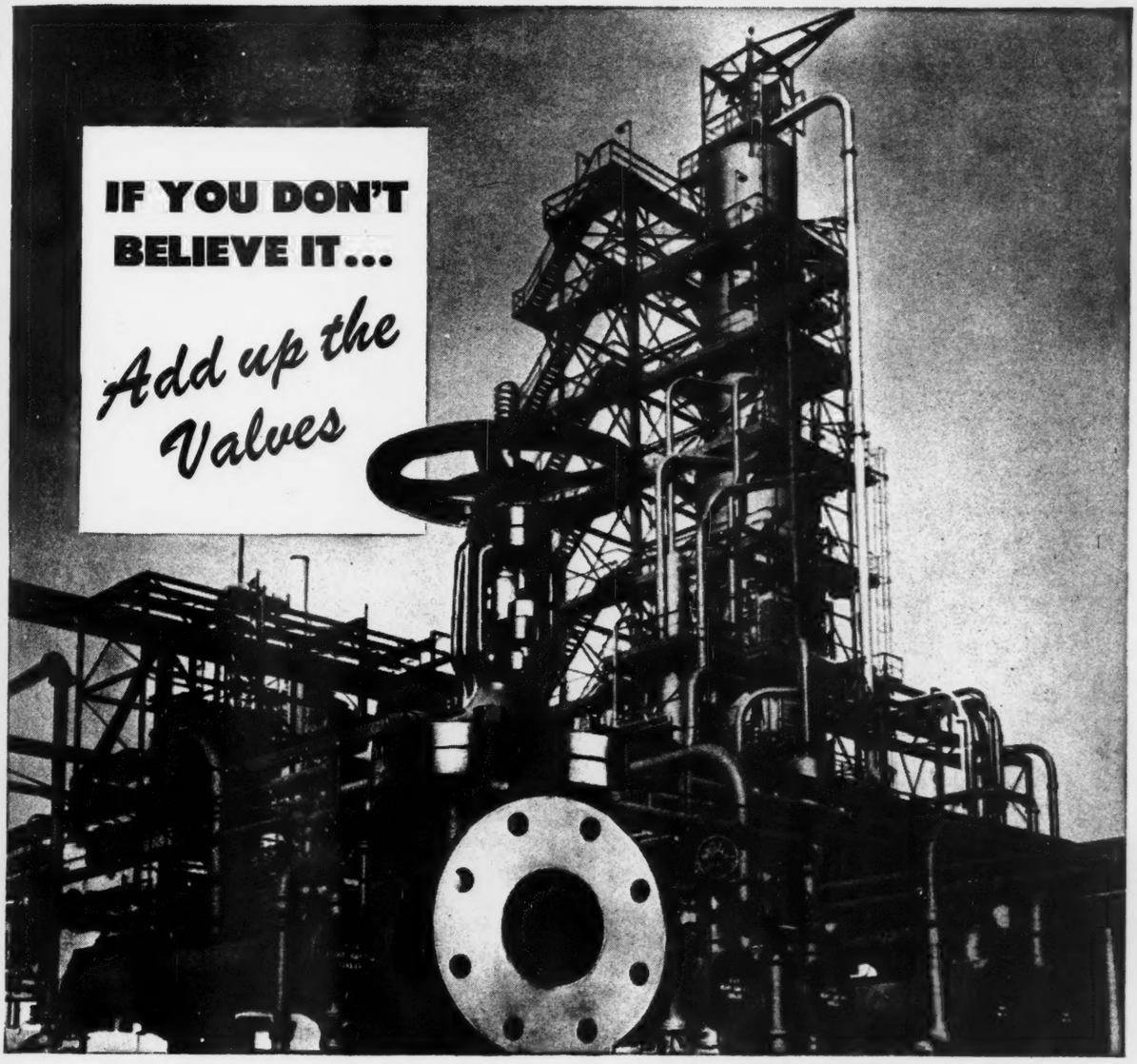

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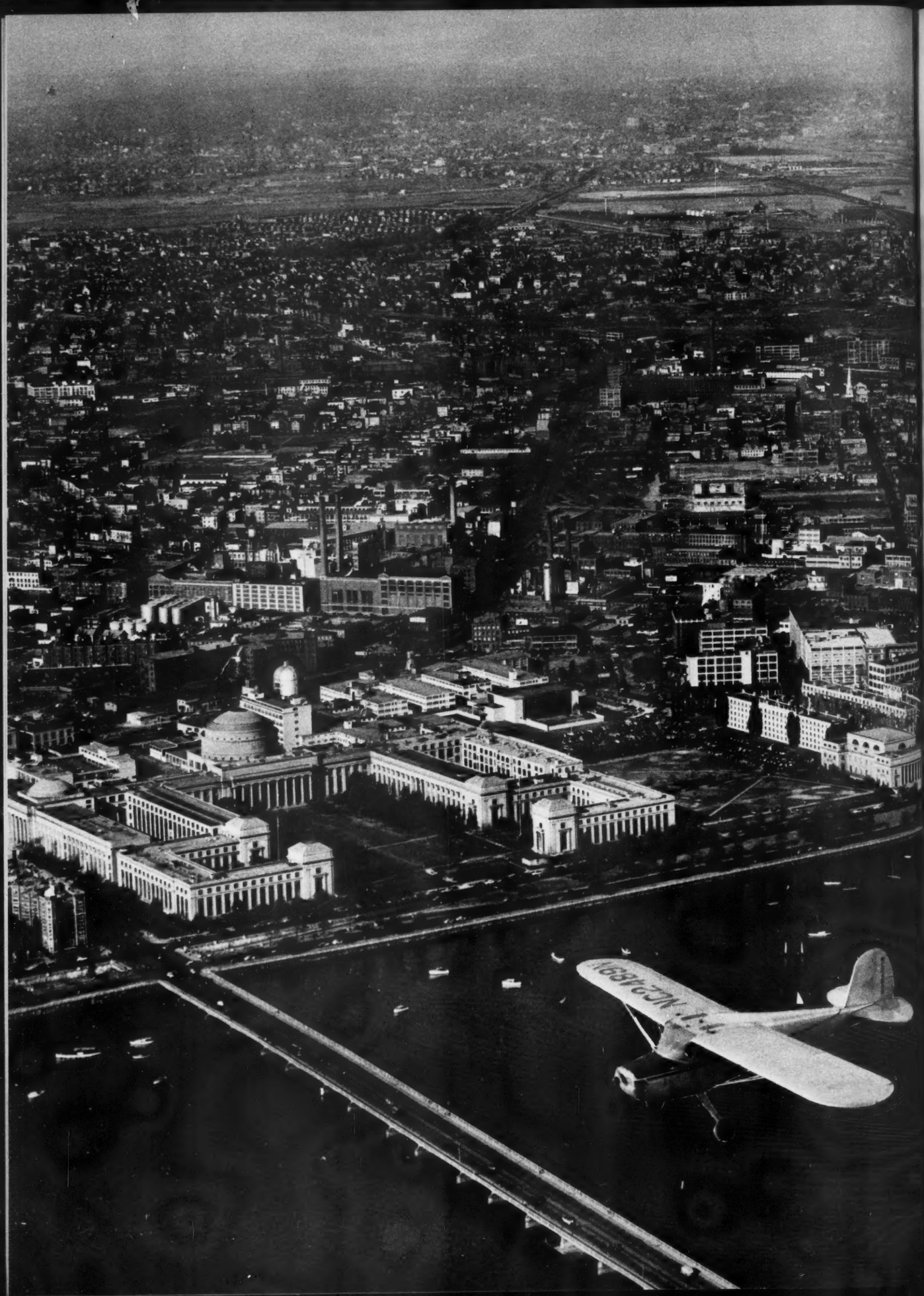

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the institute fly-boys

By Hubert Flomenhoft, D.I.C.

"Do you want to learn to fly for $3.00 an hour?"

This unobtrusive, mimeographed notice that appeared on the various bulletin boards around M. I. T. one day late in 1947 was the germ of an idea in the minds of six Tech students who had joined in flying a war surplus Aeronca L-3 during the previous year. Their experience had indicated that it was feasible to operate a flying club with as many as thirty-five men per airplane, if the membership were mainly students who found time to fly during the week, but that such a number was a basic requirement for a successful student flying club, for only in such numbers could costs be kept down to levels that a student could afford.

Just how successful this plan has been is indicated by the fact that now, only slightly more than one year later, the Tech Flying Club has expanded to over seventy-five members, owns three postwar Cessna two-place airplanes, and, with a monthly budget of better than $700, is one of the largest "businesses" of all extra-curricular activities at Tech. This budget represents an average of 200 hours of flying each month, an average which has continued even though rising costs and more conservative financial policy have forced the flying rate up to $3.50 an hour.

Furthermore, the Tech Flying Club is performing an outstanding educational function in many ways other than flight training. M. I. T. has often been criticized for providing too one-sided an environment for its undergraduate student body, who are in just those formative years when training in phases of living other than purely technical skills is so important. TFC is valuable, then, in not only encouraging social relationships between men with common interests, but in imposing adult responsibilities. That last point is no idle platitude since there is involved in this venture not only a considerable amount of capital, but also a factor of human life. Along with rigorous financial policy to maintain costs at a minimum without endangering investments or safety, strict adherence to CAA and club flight regulations must be enforced. This places the club in the position of being an independent, self-disciplining organization and gives it even greater value to its student members. The efficient enthusiasm of these rabid flyers serves as a continual reply to those who are skeptical of this kind of activity.

Say, haven't you ever been up in an airplane? Well, maybe you haven't or maybe you have only ridden commercial aircraft — or maybe you were a military pilot. (But that is not flying; it's just hanging on to the end of a stampede.) In any case, come along for a mythical hop and you can learn how the club operates.

The first step is to sign up for a plane at the club bulletin board in the hallway of Building Ten. There are three schedule sheets posted, one for each airplane. By means of these, one can tell whether or not an airplane is available at the particular time he desires; and, once having signed, he informs others that the plane is taken for that time. However, it is necessary to make

Traffic pauses as Tech flyers bring a Cessna-140 to M. I. T. for display at Open House on May 1, 1948. The plane is on its way here to the Building Six lawn.

Credit: The Boston Globe

The Navy visits the Tech Flying Club at Mountain Field, Beverly, during the Club's air show on January 8, 1949. *Credit: TFC*

The Executive Board of the Tech Flying Club poses in front of one of its planes. One of the board's duties is to decide when and by whom the planes shall be used for cross-country flights. *Credit: TFC*

the appointment binding by calling the Operations desk of the Pilgrim Flying Service at Beverly Airport, where the airplanes are based, since they keep a schedule book there of who is scheduled to fly at any particular time. Beverly is about twenty-three miles north of Boston; it takes about forty minutes to get there by train. Pilgrim provides free transportation to and from the railroad station; so, the members generally try to go out and back in groups in order that the number of trips can be reduced to a minimum.

It is an expensive inconvenience to make many telephone calls to the airport; consequently these clever engineers have come forth with a means of solving even that problem. Several of the E.E.'s are building a 460 megacycle two-way radiotelephone, which is to be set up at the desk at Beverly and in the club office in 20-E-002. Negotiations are under way for obtaining the special license on that band which permits anyone to operate the set. If this scheme is successful, it may be possible to do away with the schedule sheets and just radio the airport instead.

Transplanting ourselves to Beverly Airport, we notice first the inescapable "M. I. T. Operations" sign in the familiar red and gray as we come up the road. The building toward which it points is the office of the Pilgrim Flying Service, where the club has another bulletin board. Here items of strictly flying interest are posted, including news items of recent crashes with stern reminders of what basic rule of safe flying was ignored in causing the accident. Also, record books for each plane are kept in boxes along with hectographed inspection forms which must be filled out for each airplane by the first person to fly it that day. The pilot checks the squawk sheet for anything wrong with the airplane and then logs out before going to his plane.

Sometime during the course of these proceedings a loudspeaker over the main desk may suddenly start spouting out weather information broadcast from East Boston Airport, "Hub of the Air Universe" no longer with the Tech Flying Club operating elsewhere. . . .

"How did you know to turn your radio on just then?" asks a newcomer of Jack McNeil, who runs Pilgrim and is one of the flight instructors.

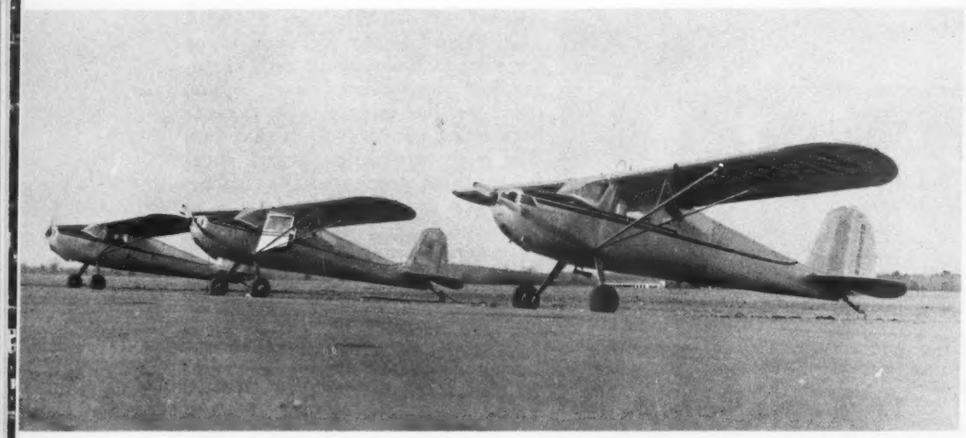
"Oh, that's a rig those M. I. T. fellows put in," he replies with a twinkle. "It operates all day, but the radio range frequency is filtered out, and the weather broadcasts are cut in automatically with a relay when they come on. They fixed up some surplus gear and set it up back of the desk here."

If those E.E.'s get any more brainstorms, the aero engineers are sure to get jealous and start hanging Jato rockets all over the planes.

Out at the hangar, you can get a good idea of just what the club owns, although it would be a rare experience indeed to find all three airplanes on the ground at the same time on any good-weather day. The first plane that was bought when the expansion program got under way was N76546, a Cessna 120, which is a basic training model used primarily for student flying. Although it was only a year old with just over 100 hours logged, the procurement committee was able to take advantage of the low winter market of 1948 to obtain it at a price far below the current standard market-depreciated value. Another bargain turned up later — a Cessna 140, N89028, which is the same as the 120 except for the addition of flaps, upholstered interior, and extra equipment designed to make it more attractive to the private owner. Finally, continued demand for expansion by prospective members led to the discovery of the best bargain of all, another 140, N2489N, whose extra equipment includes a gyrocompass, a loop antenna, a two-way radio (which 028 also has), and a fan marker receiver

around $2.25 per month. Finally, the direct flight costs are charged against each man according to the number of hours listed on the time sheets in the record book of each airplane at the airport. These charges are at the rate of $3.50 an hour for the two 140's and $3.30 an hour for the 120, which has lower maintenance costs because of less equipment. For anyone who flies three to four hours per month, this totals about half the cost of renting an equivalent plane from a commercial operator. Even those who fly only one hour per month pay less than commercial rates. Students who require dual instruction pay an additional $3.00 per hour for an instructor, which is a standard rate.

The present membership of the club consists of about half student pilots and half private pilots. In addition, there are flight instructors, Charlie Richbourg, who is also a Naval Reserve pilot, and Air Force Reserve pilot Yen Whitney, who will soon be taking the test for his flight instructor rating; so TFC definitely includes a broad background of flying experience. Some idea of the progress made in the flight training program can be obtained from the fact that fifteen men obtained their private licenses during 1948. The private pilots have been doing quite well for themselves, too, with cross-country trips to New York, Philadelphia, Washington, Chattanooga, Syracuse, and other cities. However, there are special problems associated with cross-country scheduling which will be discussed later.



Centered around its three two-place Cessnas, here shown waiting for take-off, the Club's budget runs to about seven hundred dollars each month and includes expenses of about two hundred hours' flying time in such a period. *Credit: TFC*

The acquisition of 028 with a landing light made night flying possible, and this has just begun in the last few months after the establishment of a very strict set of regulations. The gyrocompass and loop antenna in 89N make instrument flying relatively easy, and regulations should soon be set up for permitting this kind of instruction. It is certainly clear that the spirit of TFC embodies a very serious intent to provide a wide scope of training and experience for its members rather than just to provide means for "Sunday afternoon sport."

The educational function of TFC covers ground as well as air, since it goes into competition with Tech every Monday at five and seven o'clock when it presents CAA ground school films in 20-E-011. Everyone is invited to these classes free of charge — one way to attract new members. After the second showing, the executive committee meets in the club office, 20-E-002, to conduct the business of the club. All members of the flying club and anyone else may listen in on these meetings to see how the executive committee functions. This is encouraged since there is too often a lack of interest by the general membership of a large organization in how such business is carried out.

Indeed, it may be said that the most critical problem of this type of club is the apathy on the part of the general membership to join in any but flying activities. An attempt was made during the original membership drive to impress on the men the fact that additional interest in club activities would have to be a basic requirement for the selection of members; but, after the usual initial burst of enthusiasm, the primary responsibility and initiative soon gravitated on the small group who had the keenest interest in the club. This has meant on innumerable occasions that several

(*Continued on page 146*)

soon to be installed by those ambitious E.E.'s. This makes 89N the safest and most desirable airplane for cross-country flying.

Now let us take that mythical ride I promised so that you can get a look at Beverly from the air. After taking off, you can see clearly the extent of the four- to five-thousand-foot paved runways in three directions. This was a Coast Guard base during the war and is thus quite large; but there is not too much traffic now, which situation is especially advantageous for student flying. It must be remembered that the lack of flat land around Boston is the reason for the shortage of airports; the three fields closer to town are very crowded. While directly above the field, we can tune in the Boston radio range and get right on the beam of the north leg. This provides a handy safety factor for any pilot who should ever find himself unable to locate the field, although it is pretty hard to miss since it is so close to the coastline.

By the time we return to the field, you are pretty sure to be thinking about doing some flying yourself and are wondering what the financial arrangements are. Expenses are divided into three classes: capital investment, fixed monthly costs, and flying costs. When a man joins the corporation, he pays eighty dollars as his equity. Depreciation on the aircraft is subtracted from this equity and amounts to about fifteen dollars per year; the remainder is returned after a man leaves the club. Total fixed costs — which include insurance, hangar rent, and the operating costs of administration — are divided by the number of men in the club each month to obtain the dues. Some average figure is generally used so that it can be kept fairly constant,

the cat is here

By Charles M. Saltsman, '52

"My God, what is that thing?" The commodore of the New York Yacht Club stiffened in his comfortable deck chair and looked out into the bay. There, among the graceful forms of the club's sailboats, the great New York Forties and the speedy six-meters, a strange new craft was working its way toward the dock with a speed that amazed him. A group of members, arguing the probable outcome of the day's racing, halted their conversation abruptly to consider the newcomer. The craft in question was indeed strange. Looking for all the world as though it had sailed out of the pages of "Robinson Crusoe," it had two hulls instead of one. From the clubhouse porch it appeared that these hulls were fastened together with some sort of cross-members, on which was built a small enclosed cockpit. The commodore found himself wondering who would be crazy enough to anchor such a barge next to the club's proud cruisers.

When the owner of the "freak," as the yachtsmen of Long Island Sound soon christened the new sailboat, came ashore, he found many people laughing at his boat. Others were indignant that he had dared to deface the club's private anchorage with such a tub. Nevertheless, some showed mild interest in the young skipper and his vessel. Where had he found it? How did it sail? Wasn't the sail much too big for the boat? And for Heaven's sake, what was it good for? One kindly yachtsman gave the lad some advice.

"My boy, you'd better take that machine back to Tahiti. This is 1876; those outriggers of yours were outdated when Noah built the Ark."

The young man grew angry at the laughter that followed. He challenged to a race anyone who would dare to compete against his sailboat. At that, the laughter redoubled. But they raced him. And, one by one, they lost. In any kind of weather, and against any boat, the "barge" proved its supernatural speed. The laughter that had echoed up and down the Long Island coast in the spring of that year had turned to worry by the end of the summer. What was to become of the scores of great racing yachts that had shown themselves worthless against a craft invented in India ten centuries before? The national race committees had the answer. They simply outlawed the "freak" from any kind of formal yacht racing.

Thus the development of the catamaran was snuffed out for some time. But the young man who had first introduced the "cat" to the United States could not forget how he had humbled the great sailors of New York. Known today as one of the foremost yacht designers and yachtsmen that this country has ever produced, he continued throughout his life to build more and better cats. His name was Nathanael Greene Herreshoff.

Looking carefully into the design and performance of the catamaran, one can begin to see why Herreshoff was so certain of its eventual success as a racing machine. It was designed and first used by the Tamils of Southern India about 900 A.D. The name itself, "catta," meaning lashings, and "maran," logs, tells us that the first of these boats was nothing more than several logs tied together to form a crude raft.

"SEABIRD"

In view of the fact that the materials first used were clumsy at best, the phenomenal success of the cat shows that the principle behind it must be sound. The term "catamaran" today includes any vessel with more than one hull.

Tracing the history of the cat in the western world, we find that the first extensive test of the vessel was made during the reign of Charles II when several were built to determine their value as naval craft. Apparently the test was a failure, for the cat was forgotten for some time, and it was not until Herreshoff built his first one, the *Amaryllis*, that cats began to make a comeback.

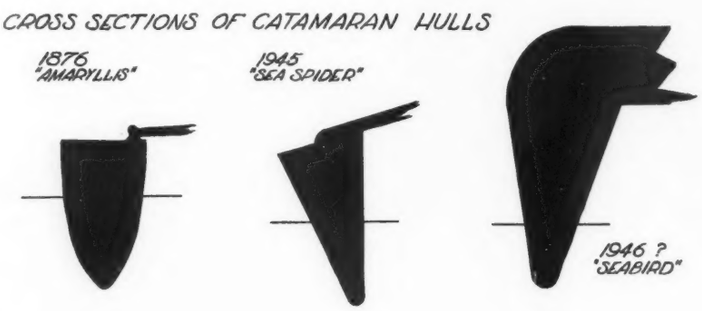
But what about the *Amaryllis?* Why was it called a "freak" by yachtsmen? Let us look a little more closely into its design and construction. First, as I have already mentioned, the *Amaryllis* had two hulls. They were quite long, thirty-three feet to be exact, with a width of only two feet and a depth of three. The underwater section of these hulls was in the shape of a parabola, which seemed to the designer to be the best shape to obtain the greatest possible speed. The hulls were spaced sixteen feet apart, giving the craft great longitudinal stability, and thereby allowing it to carry a large amount of sail. Each of the two hulls was fitted with a small centerboard and a rudder. The cat was operated from a small cockpit attached to the crosspieces. The original *Amaryllis* was put together with ball-and-socket fastenings, allowing each member to roll and pitch independently of the others. One can readily see why the boat appeared strange to the New York Yacht Club when it first made its appearance.

Tradition is a powerful element in the character of most Americans, even though they like new gadgets and different, radical designs. For the most part, they are reluctant to give up the things they know and understand for untested, though perhaps more modern and better ones. Consequently, the cat has failed to increase a great deal in popularity through the past few decades. A few have been constructed, it is true, by Herreshoff and other shipbuilders, but we have yet to see a mass swing toward the cat.

Yachtsmen had forgotten all about the cat by the time the Second World War had come to an end. They had forgotten the scare of 1876, when it seemed for a time that all of the beautiful yachts were going to become relics of the past. They had forgotten the occasional cat that would appear and outsail everything that ventured to oppose it. Indeed the cat was no longer even a memory.

Then, quite suddenly, in the spring of 1945, the yachting world received another cat shock. The Herreshoff shipyards, it was discovered, were constructing another catamaran. This time every effort was being made, not only to produce a fast boat, but to keep the cost of the cat to an absolute minimum, in order that anyone might own and sail one.

That summer, the newest cat, the *Sea Spider*, was launched. In her tests, she proved that although the ultimate of her type had by no means been reached, she was by far the finest, fastest of her kind ever constructed. She easily reached speeds of from sixteen to eighteen knots, and, perhaps best of all, she was much easier to handle than had been her predecessors.



Sea Spider is smaller than her ancestors, being only twenty-five feet long. Her hulls are triangular in cross-section, ideally shaped for plywood construction. They are divided into waterproof compartments to assure stability in case of damage. These hulls are connected by a system of spars and wires which form a pyramid on which a pivoting mast is mounted. The system has enough "give" to allow for the beating which the *Spider* might take in heavy weather. The cockpit, suspended under the framework, resembles a small rowboat. A rudder on each hull, connected by a tie-rod, allows the helmsman to steer from any position on the after part of the cat. The name *Sea Spider* describes the cat's appearance perfectly, for it looks for all the world like a giant water bug squatting on the surface of a pond with its legs spread wide for support.

There are a number of factors responsible for the speed of a catamaran. The first of these is its shallow draft. Because the craft is very wide, it does not tend to tip as does an ordinary sailboat. Thus the necessity of having a deep, weighted keel is eliminated. The latest and most radical cat is forty feet long, and yet it draws only fifteen inches of water. Because of this stability, too, the wind spills off the back of the sail, nstead of off the top, and this adds to the forward

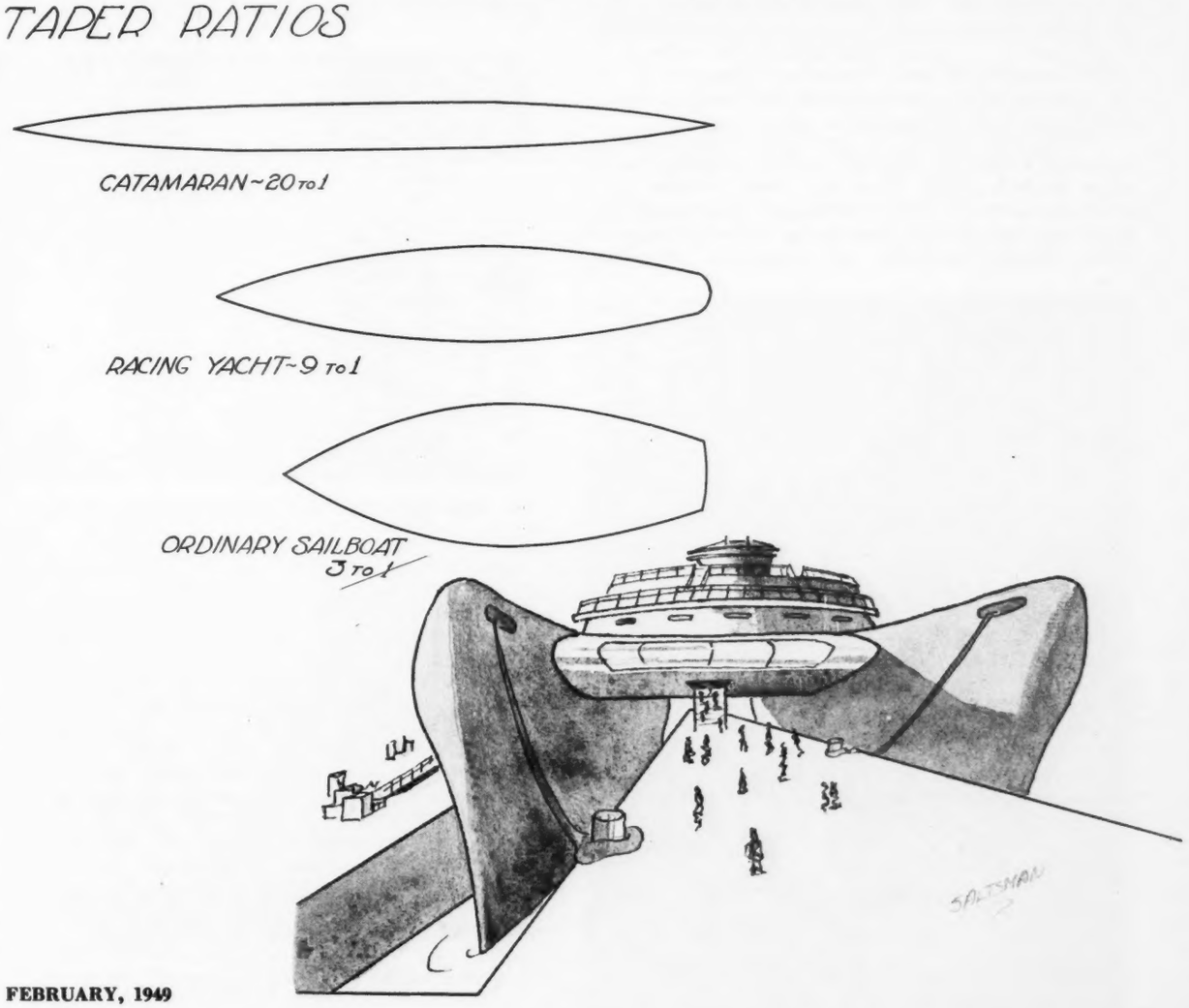
thrust of the boat. Another interesting feature of the cat, and one which is responsible for still greater speed, is the taper ratio of the hulls. It is quite easy to see why a long, narrow object is easier to push through the water than is a short, wide one. Everyone realizes that it requires a far greater force to move a rowboat than it does to move a canoe. The taper ratio, then, is the ratio of the width of a boat to its length. In an ordinary sailboat this can vary anywhere from three to one up to nine to one. A catamaran, however, has a taper ratio reaching twenty to one. A hull of this shape cuts the water like a knife blade.

The catamaran has its disadvantages, however. When we compare its features with those of an ordinary sailboat, we quickly learn what they are. To begin with, there is not as much room aboard a cat, and it is therefore not as comfortable. It is more difficult to handle, and in a strong wind it often requires an experienced skipper to keep it from tipping over. It is, furthermore, hard to handle in small areas, and in a crowded anchorage it becomes an absolute menace. It is certainly not as handsome as a trim racing yacht; but if the yachtsman wants speed, he cannot be too particular about the boat's aesthetic qualities.

There is one more development in the catamaran, which I would like to mention. In the newest cat, the forty-foot *Seabird*, the hulls are held together by a large strut which has the airfoil of, and looks much like an airplane wing. As the craft accelerates, this wing tends to lift the whole boat, and so reduce to draft, and cut the drag to a minimum. It is sufficient to say that the *Seabird* tops twenty-two knots with ease.

But what of the future of the cat? Will it survive? Not only will it survive, but it may be on the way up. For, aside from sailing cats, there are already many fuel-driven boats that make use of the principle of twin hulls. In 1942, for example, Russia built a steam driven cat seventy-eight feet long, designed to carry no less than one hundred fifty passengers. It is powered by two six hundred seventy-five horsepower engines, giving it a speed of thirty-seven miles an hour. This is not, furthermore, an isolated case. There are many others similar to it. But consider the future. Consider, if you will, the possibilities of twin-hulled liners and freighters. They are almost without limit.

Author's Note. — The short story at the beginning of this article is what might be called historical fiction. It is based on fact, the facts being simply that Herreshoff did build and sail the catamaran here described, that it did outrace all of its competitors, and that it was finally outlawed from formal yacht racing. The details and the dialogue are allegorical; that is, they are home-made but they serve to picture the way this kind of boat made its appearance to American yachting.



mineral policy

By Roland D. Parks

Associate Professor of Mineral Industry

National mineral policy may be defined broadly as the authoritative attitude of a country toward its mineral problems. This attitude should be forward-looking and it should be flexible. It will be different when directed toward domestic problems than when looking abroad and will vary under economic and political pressures, as from peace to war. It is not likely that a national mineral policy, and, particularly, the foreign phases of one, will be found set forth, point by point, in print.

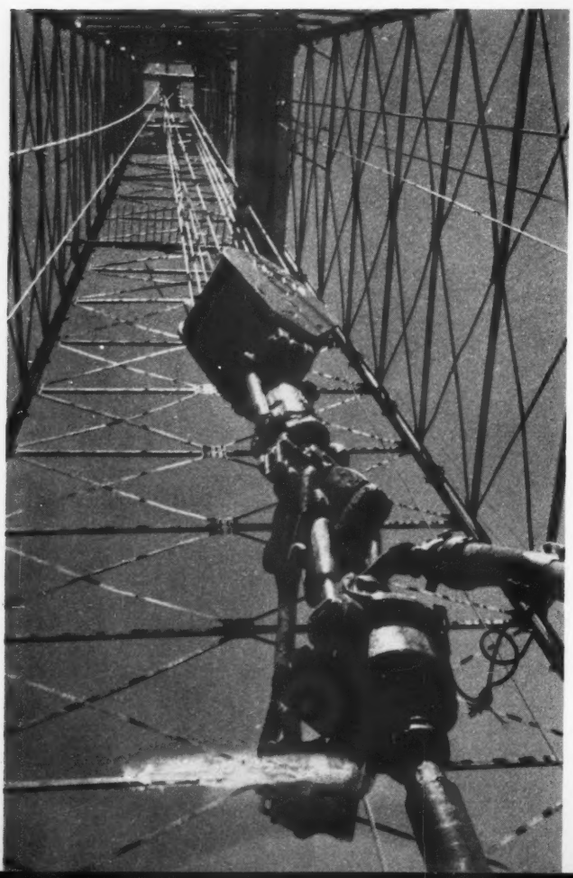
The term mineral policy has come into general usage in the last twenty-five years. Since World War II, its use has become so common that there seems to be some merit in examining the term to see what the essential features of such a policy may be. To do so should tend to clarify usage and prompt constructive discussion of vital points.

As a basis for discussion of policy, three facts must be recognized; first, that modern industrial economies are based on minerals and mineral fuels; second, that boundaries of countries bear little or no relation to mineral geography; and third, that mineral resources are wasting assets; once removed they are not replenishable naturally within time as we measure it.

Along with these facts it is recognized that no major industrial nation has domestic sources sufficient for all of its mineral needs. Even the United States, well-endowed naturally and best developed of any producer, must rely on foreign sources for many minerals of which nickel, diamonds, tin, manganese, chromite asbestos, mica, and quartz crystals are typical examples. Trade in minerals is essential to maintenance of large-scale, technically-advancing industry. The time may come when many inorganic substances will be put together synthetically to replace natural minerals, as is now the case with some abrasives. Agricultural nations and those making only a limited range of products from minerals are, in general, suppliers of minerals to major consuming centers; countries such as Chile, Venezuela, the Gold Coast, the Guianas, and Turkey are instances.

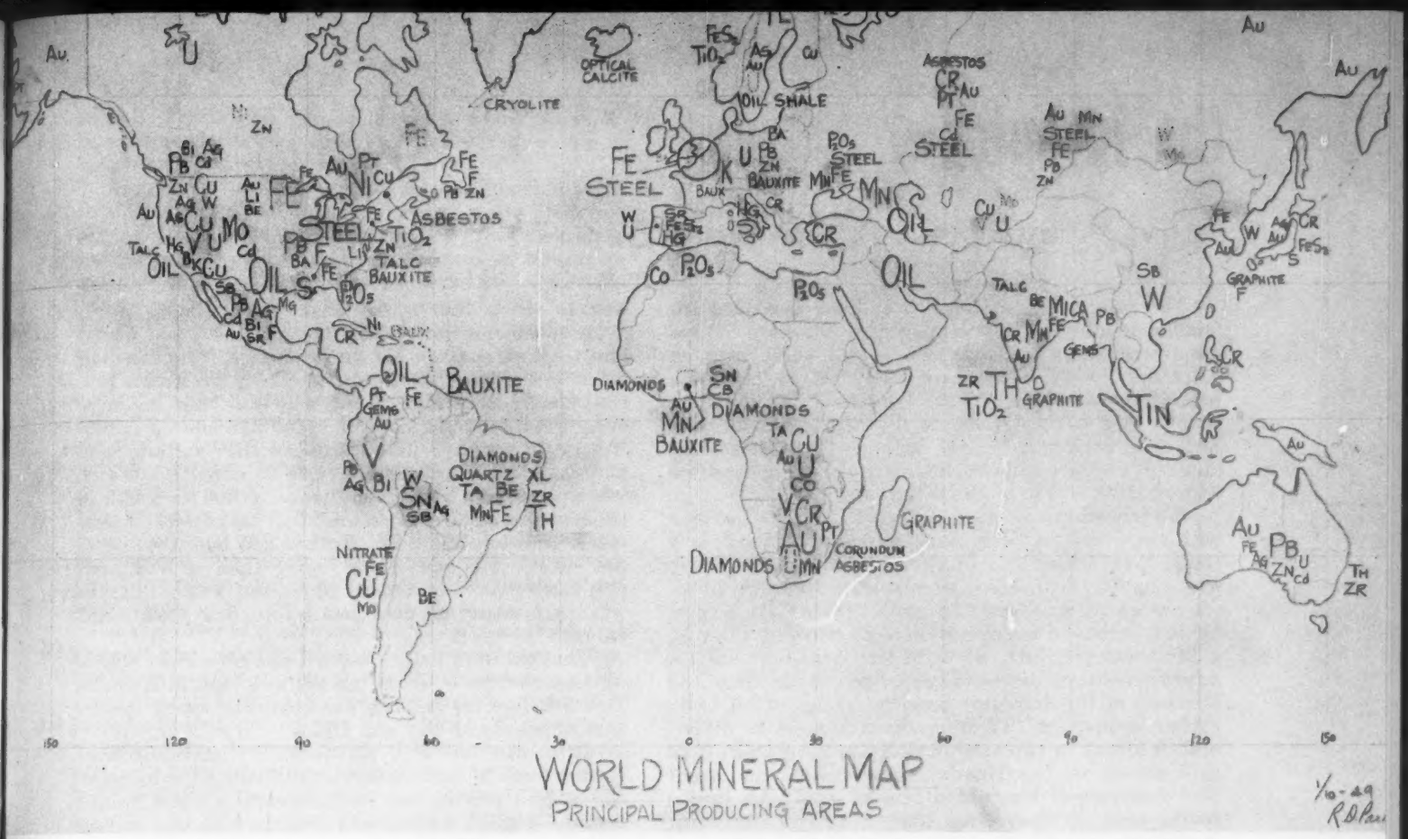
Mineral policy, thus, should be based on realistic appraisal of a country's mineral and industrial situation, both internally and with respect to competing powers. Minerals, located as they are below ground, are seldom visible until developed. A country's mineral wealth is susceptible only to progressive measurement, and any appraisal must be considered as a temporary estimate only. It follows that policy should be subject

This open-cut copper mine in Utah makes a pretty big hole . . .



. . . and this inside view of an oil-rig in Southern Wyoming makes it look like a pretty tall affair.

Credit: Roland D. Parks



Principal production of some fifty minerals is shown on the world map above. Coal, largest of all in tonnage but widespread in distribution, has been omitted, major production being tributary to steel centers. Building and ceramic materials and minor items generally, have also been omitted. Size of printed symbol is indicative of importance of production, though not to scale. Major centers are shown in iron ore, copper, lead, zinc, etc., where minor production is distributed. Nickel, molybdenum, asbestos, cobalt, tin are confined to few production centers. Single sources of supply are given for cryolite, optical calcite, quartz crystal, corundum, nitrates, columbium although some are found in other localities. Reported potential production of current interest is noted in dotted symbols.

to revision promptly upon new mineral evidence — Labrador iron ore as a case in point.

Domestic vs. Foreign Mineral Policy

Domestic mineral policy is concerned with the finding, appraising, producing, and using of a country's own resources; whereas foreign mineral policy relates to problems encountered in drawing on some other country's resources. In a broad way, the terms conservation and trade would seem to distinguish basically between these two phases of overall mineral policy.

Conservation implies efficient production and usage and the preserving of unworked deposits or remaining portions in such state as not to preclude further availability. In foreign fields, concern is with procurement, if minerals are merely being purchased, or with production and procurement, if capital is being invested in the foreign country. In either case the foreign government will be involved directly or indirectly and the general form of the transactions might be labeled trade.

In general, three philosophies of ownership are extant in the mineral field. Crown ownership vs. private was the original division on this question. From this, two general classes of mining laws and mineral titles resulted — the concession system and the claim system. State ownership and operation is a more recent socialized variation employing the "closed door" policy to its extreme.

Attitudes, naturally, will differ under these varied circumstances; much will depend on the stage of advancement in industrial development of the countries concerned and from which end of the transaction the situation is viewed. Objectively, two countries may hold similar, even parallel policies, these consequently clashing head-on when put into operation, as with off-setting tariffs or import quotas.

Much will depend also on international relations and upon a nation's ability and determination to procure minerals from foreign sources for its needs — whether by trade, imperialism, or war. A country's internal condition and political thought will be a powerful influence in all such decisions.

Mineral Problems

Within this broad field of mineral policy, the full range of problems may be broken down or separated into three rather distinct groups; those (*a*) inherent in the mineral industry, (*b*) related to national security and well-being, and (*c*) of an international nature.

Relatively narrower groups, often referred to as elements of mineral policy, may be set up within this framework, somewhat as follows:

Mineral Industry

Finding and developing new resources
Production
Marketing and Use
Technology

(*Continued on page 148*)

the inventor

By Robert P. Donovan, '52

The names of Franklin, Edison, and Goodyear are familiar to all of us, and with each we associate certain discoveries or inventions. We accept these men as great but seldom do we ever stop and ask ourselves just what made them great. What qualities did they possess that enabled them to do things that no man had ever been able to do before? To answer this question we must glance back over their lives and see just what type of individuals they were.

We immediately link the name of Charles Goodyear with the discovery of vulcanizing rubber. There is a tragic story behind this discovery, however. Goodyear was a happily married man until his work in his hardware store brought him into contact with india rubber. He had improved the operation of an inflating valve on a life preserver, and, when he attempted to sell his improvement to the company which made them, he was told of the desperate financial status of all india rubber companies. Their products seemed to deteriorate a month or two after completion. Amazed at the skill shown in Goodyear's improvement, the agent who interviewed him urged him to apply his genius to the task of discovering some means of imparting durability to rubber and assured him that fame and fortune as well as the knowledge that he had saved the rubber industry from complete failure awaited him if he could produce a solution.

Thus Goodyear set out on his quest for a process that would make rubber durable, a task that marked the end of his happiness. His initial success in a few experiments encouraged him, and although they were of little value, they kindled the fire in his heart that was to drive him on against overwhelming odds. Subsequent experiments left him penniless and forced him to pawn some of his wife's jewelry. But his debt did not stop here; more experimenting ran up his bill. Only timely loans from friends who were thinking more of his family than of his work saved him and his family from real poverty. His discovery that sulfuric acid hardens rubber tricked him into thinking his search was over. After selling thousands of dollars worth of rubber merchandise, he realized that his present process toughened only the outer surface and that the life of the rubber was not much longer than it had been previously. It was a hard blow, but aware that he was much nearer his goal than before, he redoubled his efforts.

Charles Goodyear

That his work had exhausted him physically was so obvious that he believed himself in a race with death. Death before his mission was complete was a spectre that haunted him day and night.

In connection with his durability tests, he wore clothes made of india rubber at all times. His haggard, sallow face peering out from beneath a black rubber hat and a black rubber coat presented an odd picture which fully justified the opinion of many in believing him to be mad. Even his family, now numbering six children, lost faith in him. They applauded his several successes but felt that to continue in face of his and others' failures and leave his family in their miserable condition would be criminal. But he had endured so much and felt the call to continue so strongly that he could not and would not turn back. And so, he alone crossed the finish line at the end of his search. There was no one to cheer him or to shake his hand, and the world expressed its gratitude to him by seizing his patent rights. He was worn out and disappointed and his spirit is reflected in this message he left, concerning the future of his sons: "Make them anything but inventors; mankind has nothing but cuffs and kicks for those who try to do it a service."

All inventors do not lead the life of hardship that Goodyear did. A many-sided man like Benjamin Franklin refused to become slave to a goal. Once Franklin's newspaper was well-established in Philadelphia, he had few worries and many interests which he developed as he wished. Early in his life he had learned the art of winning friends. Consequently he was continually being elected to public offices, such as the city council. In order that his suggestions might receive a thoughtful reception, he always printed an editorial or column about them before he mentioned them at a meeting. In this way most citizens were familiar with the problems when they were brought up and speedier action usually followed.

From among his close friends he organized a secret club called the Junto which met regularly to discuss any topic which seemed to be of interest. These topics varied from poetry writing to scientific experimenting, and it is to this group that Franklin first disclosed the results of his famous kite experiment. More often the members of Junto would work together on an experiment and benefit from the observations of others

as well as their own. It was a club in which the members enjoyed working with each other and served as means of relaxation for them.

Franklin's wit has been the subject of much marvel. In *Poor Richard's Almanac* he has left many "just and original observations on success in life" (more than other writers past or present and yet we think of him as an inventor). It has been said that he did for the earthly man what Solomon did for the spiritual man. Truly, his *Poor Richard's* are but a collection of receipts for laying up treasures on earth.

Later in his life his skill in handling people was recognized by the United States Government, and he was appointed as a special envoy to France to enlist her aid in the American Revolution. The success of his efforts eventually brought France to our side.

Franklin lived a full life in many different fields. That he never applied for a patent for any of his inventions prevented him from accumulating a vast pecuniary fortune, but his many interests and stimulating friends preserved his peace of mind, which he valued more highly.

When a boy of twelve makes a violin unassisted, and becomes the neighborhood violin repair man, when this same boy can completely tear apart and reassemble a watch with but one try, that boy is something of a genius. Such a person was Eli Whitney. During the Revolutionary War he, again unassisted, made tools with which he could produce nails, a very scarce item in those days. Even when the war was over he found a use for his nails by converting them into ladies' hat pins, and a Whitney pin was soon recognized to be the finest pin on the market.

He was aware of the value of a liberal education and entered Yale College in 1789. Three years later he had his degree and was hired by General Greene of Georgia as a private tutor for his family. Before long his inventive genius was at work again, and he repaired many things about the Greene household, the most notable of which was Mrs. Greene's embroidery frame. Shortly afterwards a group of gentlemen visited the General and the conversation turned to agriculture. It was remarked that unfortunately there was no means of cleaning the staple of the green cotton seed. Separating one pound of the clean staple from the seed was a day's work for a woman. Mrs. Greene, remembering Whitney's work on her frame, interrupted their lamenting by telling them of his genius. He disclaimed all credit for skill but set right to work upon the task of inventing and constructing the machine on which his fame lies.

A fellow alumnus by the name of Miller, who was also tutoring in Georgia at that time, proposed to finance his expedition, provided he would share the profits equally. He readily embraced the offer and the firm of Miller and Whitney was established. The news of his work could not remain a secret long, and people of all sorts from all parts came to see the machine. So eager were they that they broke into his workshop and carried off his model before it was finished or even patented. Thus he found that there were already several gins operating when he was ready to unveil his supposed unknown machine.

All charges of infringement of patent brought to court were either put off or defeated outright, giving rise to even more infringement. Only by selling better gins and more of them than his infringers could he hope to outdo them. Lack of funds handicapped him considerably, but he managed to build a factory in New Haven, Conn., which was slowly accomplishing his purpose in forcing competitor after competitor out of

Eli Whitney

business when fate dealt him a cruel blow. Fire destroyed his manufacturing plant and left him thousands of dollars in debt. But he seemed to possess a literally unconquerable spirit. He decided to fight for his patent right. His personal appearance in court won much favor for him, for he was tall and dignified and had an open pleasant face. Although he felt resentment against those who had offended him, he was always able to remain cool regardless of how hot his opposition waxed. Many years of courtroom controversy finally won him enough decisions to pay his debt and live comfortably with his wife for the rest of his life.

Cyrus H. McCormick is famous for his invention of the reaper. Actually, he and his father collaborated in its invention. His father had labored for years on a machine that he hoped would cut standing grain in any of its beaten down forms, but failure after failure attended his work until he was too old to continue. Against his father's wish the younger McCormick took up his father's work and after years of discouragement, completed it. Although he patented it in 1834, he did not start producing reapers until 1840. Rather than put an inferior machine on the market and legally rob his customers of thousands of dollars, he chose to improve it as best he could before manufacturing.

He chose Chicago as the site for a plant, since it was within easy shipping distance of the western plains as well as the farm land of Illinois and Indiana. Sales soon built his company into one of the largest in the Chicago area until it was destroyed by the famous Chicago fire of 1871. Just like other inventors he let this misfortune serve only to strengthen his purpose rather than weaken, and unlike other inventors, he had already accumulated enough wealth to repair the damage.

Because he had no serious infringements made on his patent, he was quite fortunate. The world appreciated what he had done for it, and he was one of the few inventors who lived long enough to see himself and his work appreciated.

question mark, period

By John F. Moore, '49

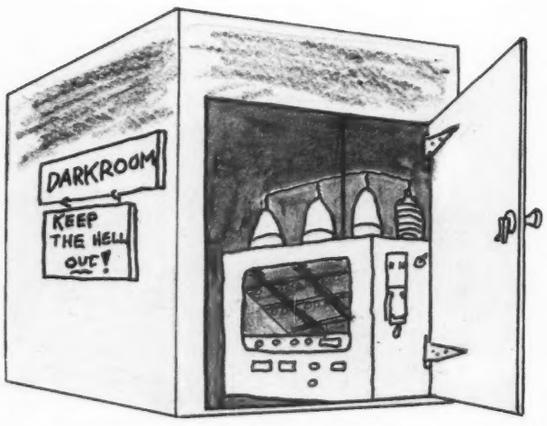
Plausible Even If Confusing

If you saw the room, you'd think it was the junk-heap of all the sciences. Chemicals, bio-slides, and crystallography models littered the floor, while shelves and half-open drawers displayed cables and wave guides, vacuum tubes from subminiature to 50 kw tetrodes, and disorganized pieces of vacuum-system glassware. If you weren't careful, you'd kick a few lead cylinders marked with the crossed-circle symbol and the words "Radiation Hazard" or a pressure tank with a scrawled card that said "Heavy Hydrogen — go easy on this, fellows, it's all we've got." Probably, you'd gaze at these and their companion wonders, and not even notice the man-sized black box in one corner marked "DARKROOM — stay the hell *out!*" But you'd notice it soon enough when the door opened, and you caught a glimpse of unnaturally wound coils and palely glowing tubes that surrounded an opening. And though you saw that the opening wasn't a tele-screen and couldn't be more than two feet deep, because of the back wall, within it were visible rows of dim red bulbs stretching back for over two dozen yards. The two men who came out of the darkroom were carrying what looked like a cross between a photo-enlarger and a microfilm projector. They set it down, and one of them took off his smock and spoke.

"John, I didn't want to tell you this until after we did the job, but one of the technicians who's been helping us around here was a security monitor, and I found out that he has reported us to Institute Security."

"Us? We haven't let a word of this project get outside the lab — and they promised us we could work without interference."

"Yeah — that promise was to get us off guard. I don't know yet what we're supposed to have done, but Security felt it was important enough so that you're going to be called before the corporation president for an explanation. That's the news I'm supposed to break to you. You'd better go now — he wants to see you at five, and it's four-fifty now."



Dr. John Malvern sometimes wished he wasn't the Institute's youngest full professor and that he wasn't working in such a security-ridden field. He knew that no security leakage had taken place, but he remembered the last scare, when one of the Nuclear Studies researchers was suspected of a little free talking. They never proved anything, but the poor fellow was blackballed for a job forever after. Dr. Malvern washed his hands and was starting to untie his smock when a technician entered the lab.

"Security, Sir. You're to come, as you are, with me."

"I guess you're the sneak who pretended to help us and then lied that we broke secrecy. If I ever get — "

"Excuse me — I only quoted your own words in my report. If the Institute Security Board thinks a leak has occurred, it's because you said so."

"Damn the Board. I wish the Army had kept this project or else given it to us without all this red tape."

Dr. Malvern's partner put his hand to his lips.

"John, you'd better go along quietly. If you had to go before the Institute Board, those old fools would never clear you. But if you see the president, I think he'll understand and back us to the limit."

* * *

The president and Dr. Malvern sat opposite each other near the head of the large table in the conference room. Dr. Malvern looked around uncomfortably and wished he'd had a chance to take off his laboratory smock. It didn't go well with all the polished wood furniture and panelling. The president frowned a moment.

"This is the first time since I took office that I have been personally involved in a matter relating to the research laboratories. Only the importance of your work makes me see you. Security reports that you have allowed information on our temporal study program to leave this area. I need not stress the fact that ever since the Army let us take over this project under our own supervision, the Institute has been responsible for security. Any breach will damage us in the eyes of the Government and the public. Though we will not take action against you, we cannot use our influence to side with you in case of further prosecution. I want to hear, in full, your version of the leakage, Dr. Malvern. Is the Security report false?"

"I know you're hoping I'll deny the report. I could easily enough, because no one outside the laboratory knows any of our specific work. But it's true that information left this area. I think I can show you that it did so in a way that can do no damage, in spite of Security and their precious monitors."

"That's absurd! Any leakage is damaging. And how can there be a leakage without someone knowing?"

"Give me time to tell you. We're currently working on the Milne-Heisenberg limitation — "

"I know that; go on."

Wait a minute. You were confused enough by that lab. We may as well get a bit of historical background that will clear things up.

Temporal transfer. *Time travel!* A dream that has overloaded the pages of science fiction stories and tickled the speculation of philosophers. The discovery that counted — as momentous as Rutherford's first artificial transmutation — was back in the seventies, when the Army Horological Laboratories in the New Mexico Research Area produced a stress-field that was able to send a low-frequency tuned circuit back in time a few milliseconds. They were able to observe this by the phase shift. Since they couldn't do much more, it became a pretty well-established idea that only non-matter, such as electric or magnetic effects, could be transferred in time. Which was foolish, because what is matter but a conglomeration of electric and magnetic effects combined with a few other non-material quantities? Anyway, the Army's stress-field provided the basis for all later experiments — except those of Professor Tywood. Working alone, he found matter could be transferred if you supplied mc^2 of energy at this end to send back a given mass. Because of the huge amounts of energy involved, he worked with micrograms and called it micro-temporal translation. He measured his results by watching the alteration in the decay curves of radioactive tracers that he sent back for a few minutes. Most of the time he worked with micrograms — until he lost his life and drained all the energy from a plutonium pile trying to send two pounds of chem text back to ancient Greece.

Then the Army really clamped down and went in for temporal research in earnest. One indiscreet general even hinted of the possibility of declaring war and then sending back an A-bomb into the land of the enemy so that it would arrive before the declaration. Perhaps this general was exaggerative as well as indiscreet, because the Army kept running into trouble. They would send back exquisite tiny clocks, and these would sometimes come out of the experiment with their hands shifted by the amount of time-transfer — and sometimes they would disappear completely, causing no end of worry. They didn't know why the clocks disappeared, but they ran some quantitative tests, and found that the product of the energy that was sent back in time and the size Δt of the time transfer, had to be less than a certain amount to keep the clock from disappearing. If a mass is sent back, its Einstein energy must be used, so the formula is $mc^2\Delta t < H$. With luck, you can send a gram back for about five days — actually it's 4.6×10^5 seconds — without having it disappear. This means H is 4.14×10^{26} erg-seconds. "H" has the same units as the "h" in the Heisenberg uncertainty principle, and when Milne's kinematic relativity theoretically verified the size of "H," they called it the Milne-Heisenberg constant.

Milne's relativity theory says, among other things, that the wave-length of light from a certain source will appear to get shorter as time goes on, so that far in the past light was redder than now. This seemed to explain the "red-shift" in the light of distant nebulae, since light reaching the earth now was emitted from the nebulae far in the past. Experimental verification of Milne's work wasn't positive until 1983, when the results of a thirty-two year study of mon-isotopic mercury vapor light were made public. Anyway, what Milne's theory meant for temporal transfer was that if you sent something back too far, the natural frequency of the atoms is "out of tune" with the surroundings.

This was all very evident, but the actual disappearances weren't explained until, in an unprecedented disclosure from India, Jollard came out with a lot of math that was acclaimed as the "switch-yard theory." Science-fiction magazines claimed that they had always been talking about it as "probability time tracks" but the theory itself was a little more complicated. Jollard's tensor equations said that every event that can be settled in either of two ways (that is, every *choice*), can give rise to two subsequent series of events. The world we exist in has in it the series of events that resulted from all the choices made in the past. If some of the choices had been different, the subsequent series of events would be different, and we'd be living in a different world. The total of all the different worlds of event-series is like a vast switch-yard at a railroad terminal. As you go down the track, you are continually confronted by switches — choices, that is. Once you've passed a switch, subsequent events, and what subsequent switches (or choices) you will be exposed to, are determined by which way you went. Jollard says that the other tracks, which are unreal to us, have a certain amount of pseudo-reality, so that if an energy or mass is sent back far enough in time, it creates a choice where one did not previously exist. This new choice leads to a different track, and the object we send back follows that different track, and, as far as this world is concerned, it disappears. However, for a new switch to be created, the amount of travel must be equal to or greater than H, as we noticed above, or the Milne effect will be too small to create a switch. However, even though the amount of travel may be less than H, if the time transfer causes a previously existing "switch" to take a different course, disappearance will still occur. An example of this would be if you were murdered in your sleep, and the next day a friend wrote out a warning, and sent it back so that you saw it the previous night. Well, you'd escape the murder, but that would give rise to a different chain of events than if you hadn't escaped, and your alive self would be on a different track than the friend who had helped you — so he'd never know he'd done any good!

So, sometimes the sample that was sent back in time would appear as expected right up to the limit of H, and sometimes it would disappear far below the limit. All the experimenters knew was that in such cases, the sample must have had undue influence in the past. Up to the moment, this "influence" was an immeasurable quantity, and Dr. Malvern had been trying to make it a little more measurable. And how did he break Security? Listen:

"I was trying to explore the 'influence' factor in the Milne-Heisenberg limitation by sending back an assortment of samples — printed pages, chemicals, pieces of equipment, for periods of anywhere between a few hours and forty years. Results were completely unsystematic until I realized that the influence factor was to a great extent psychological, since my samples might or might not influence the behavior of human beings.

"I worked out the plans for a broad experiment that could add to our knowledge no matter what happened. I decided to send back neither matter nor energy, but *information*. Of course, it takes a little energy to carry information, but a small enough amount so that I could go back several decades and still be below the M-H limitation by several orders of magnitude. I knew that soon after law documents were first microfilmed, Federal Legal Corporation set up a factory for the

(*Continued on page 148*)

the tech engineering news

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from the editor's notebook

Tech Is Hell, Eh?

In perusing our exchanges recently, we ran across an editorial in the December issue of our counterpart at Purdue. Evaporated to dryness, it might read like this: "Many engineering students are engineering students because they 'always wanted to be'; yet these students find no pleasure at all in those courses an engineer should enjoy. . . . Four years of college is a comparatively short time, but imagine forty years of such lack of enjoyment in one's work! . . . Why not let college train you for that field for which you are best fitted and would consequently enjoy most? . . . Talk it over with your faculty, analyze yourself, take aptitude tests if need be."

Noticing a few friends around Tech, we thought the *Engineer* had a point when it mentioned that life leads only to the grave, and asked if there were any reason for going to Hell prematurely.

Although it's probably back news now (our issues are made up five weeks in advance of selling date) we hear that Soviet architects have been added to the list of geneticists, artists, musicians, economists and writers in being censured, directly or indirectly, by the Kremlin for allowing bourgeois tendencies to creep into their work. Although we can see where some might consider it necessary in building a "new culture" to suppress certain forms in the arts, the question of the geneticists still bothers us. How can anyone be so foolish as to *suppress* accepted scientific theories, as it seems was done, and still expect to build that "new culture" on a sound basis? Or maybe it's more proof that scientists, even in their own fields, are not the political nonentities we are led to believe.

K. K.

All New Faces . . .

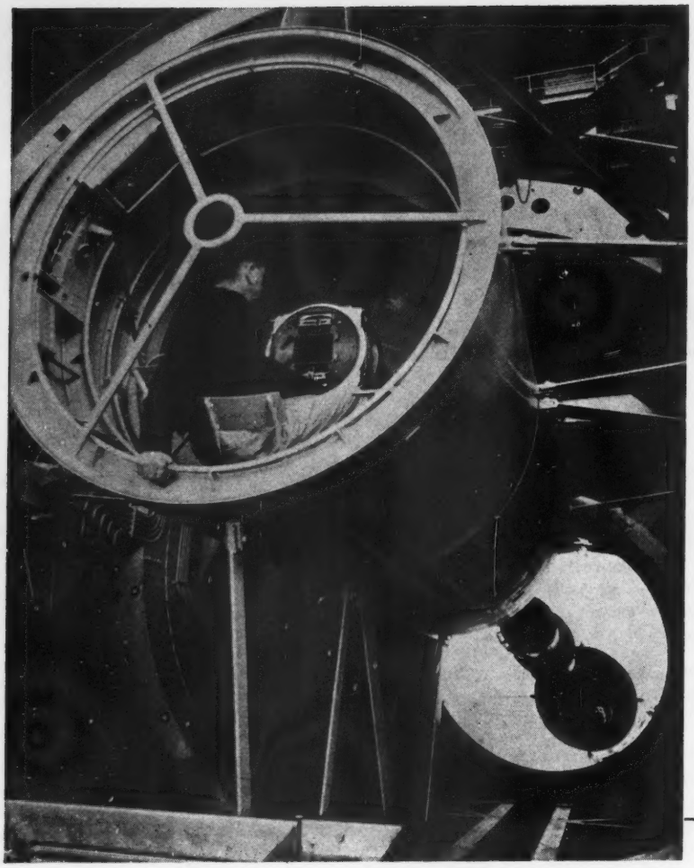
Hubert Flomenhoft, author of this issue's lead article on the "Tech Flying Club," has been head of the Maintenance Committee of that organization while a member of the D.I.C. staff working under a Naval contract. Graduated from Rensselaer Polytech in 1945 with a B.A. in Aeronautical Engineering, Hugh spent the better part of a year as an ensign in the Navy before coming to Tech, where he received his Master's in Aero E.

Whether or not to publish "science fiction" has always bothered us, but when **John F. Moore,** '49, brought in "Question Mark, Period," there was no question in the matter. Moore is probably one of the most interesting students at M. I. T. It seems that the number of his interests is unlimited — one can discuss intelligently with him almost any subject. Recently married, he is completing four years of Course VIII work in three; he is an active member of the Tech Model Railroad Club, and chairman of the Lecture Series Committee.

Professor Roland D. Parks, author of this issue's article on "Mineral Policy," Associate Professor of Mineral Industry, has been at M. I. T. since 1940. Having studied mining, mine valuation, and mineral economics, Professor Parks was associated with the War Production Board from 1941 to 1946 and has just had published the third edition of his book, "Examination and Valuation of Mineral Property."

Charles M. Saltsman, '52, has been helping sales out at the office on the art and make-up staffs but this issue's article on the catamaran is his first time to break into print here. Always interested in sailing, he hopes to enter the course in Naval Architecture. He explains his interest in sailing as derived from members of his family who, for generations back, piloted American ships over the world.

Robert Donovan, '52, has come to Tech from Norristown, Pa., to study, probably, Civil Engineering. Member of the Student Faculty Committee, freshman soccer squad, and the glee club, Bob is also writing for *T. E. N.*, as evidenced by his first contribution — "The Inventor."



1,000,000 pounds that move with micrometer precision on SKF Ball and Roller Bearings

The new telescope at Mt. Palomar moves its massive 500 tons with pin point precision on SKF Ball and Roller Bearings . . . . over 5,500 SKF Bearings in all.

This is another of the interesting and imaginative assignments that cross the desks and drawing boards of the SKF Engineer. SKF Industries, Inc., Philadelphia 32, Pa. 6736

Industrial Ball and Roller Bearings

Engineered by SKF

the institute fly-boys

(*Continued from page 134*)

men have been tied down with an unfair share of work. These men have been, of course, the club officers, and it would be apropos at this point to mention that President Tom Cuthbert, '50, has been a very rare sparkplug for the club. It takes a fanatic to spend days on end in the workshop and at the airport to make sure that seventy-five men can continue flying, and Tom is just that crazy about flying. Others who are only slightly less crazy are Leonard Nippe, '50, Vice-President, Ed Jacobsen, '50, Head of Operations, and Johnny Sorrels, '50, Treasurer. These "Fiery Four" are shown standing proudly in front of 89N the day it was bought.

Another characteristic problem of the "capacity" flying club is the conflict between cross-country requests and the high demand for local flying. Because of the great number of men per plane, the club must be regarded as primarily for local flying with cross-country a special privilege. A basic policy has been established, then, of allowing only one airplane to go out on cross-country, generally 89N, except for periods of low local demand, such as college holidays. In addition, a standard form must be submitted to the President, who, with the concurrence of the Executive Committee, passes it or turns it down. Consideration is given to cross-country experience, previous cross-country flights, length and time of the cross-country related to the home demand at that time, and particularly the amount of extra interest in club activities that the individual has shown. Obviously, requests for cross-country during the week present practically no problem.

The extent of TFC activities has definitely gone into the realm of the spectacular. For instance, at the M. I. T. Open House last spring, Tech men and neighbors in Cambridge were treated to the rare sight of a super-duper Cessna 140 sailing down to a landing in Briggs' Field and then taxiing down Memorial Drive under the watchful eye of M.C. Tom Cuthbert. It was put on exhibit on the lawn outside of Building Six. A similar stunt was arranged for January 12 when one of the club's planes was brought into the Building Ten lobby for exhibit.

Not to be outdone, some promoters-extraordinary staged, on January 8, the most glamorous air show since Air Force Day. With the Wellesley Flying Club as honored guests, an Eastern Airlines pilot raced his 180 m.p.h. midget racer for the benefit of the crowd — but mostly the girls — and a squadron of F6F's and F4U's came up from NAS, Squantum, to demonstrate military aerobatics and carrier break-ups and landings. Oh yes, the club's red-hot Cessnas were also flown, again for the benefit of the Wellesley girls, who were given rides by the chivalrous TFC boys.

What these fellows will do next is anybody's guess — be sure not to suggest any seemingly fantastic thing as a joke, because, sure enough, they will go ahead and do it!

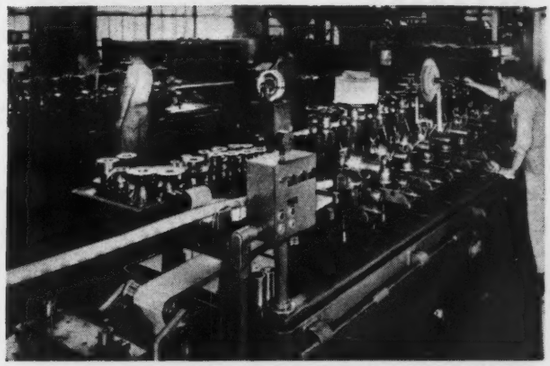
PROBLEM:

How to put a new type of covering on telephone cable

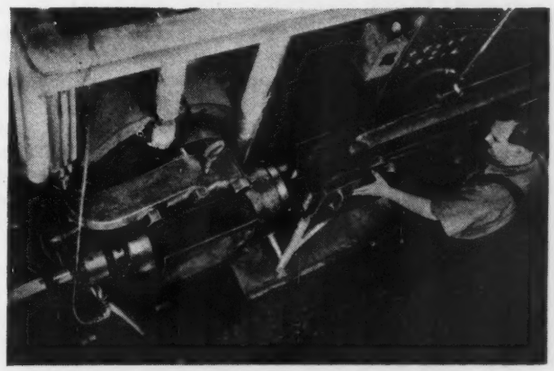
Make a new type of cable sheath no one has ever made before—make it to rigid specifications—make it fast! That was the challenge put up to Western Electric's manufacturing engineers.

The new type of cable sheath—developed through cooperative research at Bell Telephone Laboratories and Western Electric Company—is a valuable alternative to the traditional lead covering for telephone cable. It is called Alpeth. "Al" stands for an inner shield of aluminum; "peth" for the outer coating of the plastic, polyethlene.

To produce this new cable sheath, Western Electric engineers developed the Alpeth production line—a combination of new machines and new manufacturing techniques—which turns out finished cable in a fast-moving, straight-line operation.



From the desert-dry 125° F "hot room" where thoroughly dried cable cores are stored, the core moves into this machine. An aluminum strip is fed from a supply reel underneath. After being corrugated to provide flexibility and strength, the aluminum strip is wrapped around the core and flooded with a sticky protective compound.

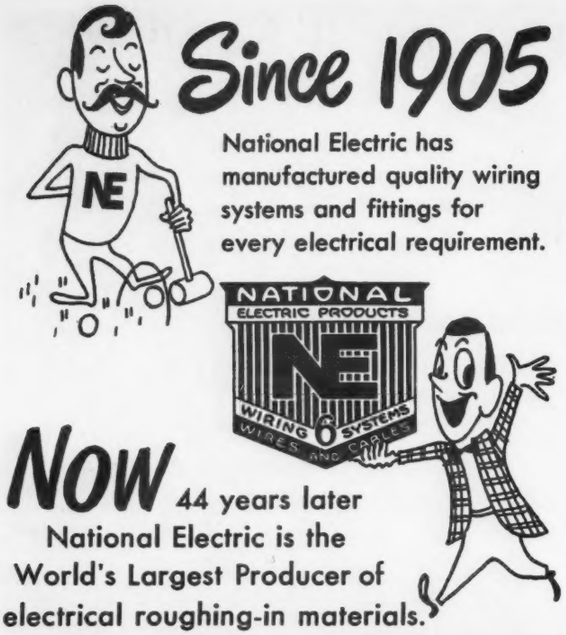


The aluminum-clad cable then passes into this machine and comes out seconds later with an extruded coating of flexible, impervious, gleaming black polyethylene. Finally, after a 100-foot bath in a cooling trough, the finished cable is wound on reels and readied for shipment to Bell Telephone companies.

Engineering problems *are many and varied at Western Electric, where manufacturing telephone and radio apparatus for the Bell System is the primary job. Engineers of many kinds—electrical, mechanical, industrial, chemical, metallurgical—are constantly working to devise and improve machines and processes for production of highest quality communications equipment.*

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882



question mark, period

(*Continued from page 143*)

automatic handling and processing of valuable papers in microfilm form. I set up our temporal-transfer apparatus so as to be directly in front of unexposed film in the factory's processing darkroom in 1959, and projected my information — all in good legal form — from microfilms I'd made here in the lab, back onto that microfilm thirty years in the past. Then I energized the little photochemical 'exposed' indicator with a brief shot of light, so that when the film was taken out, it wouldn't appear to be still unexposed. That was all — and then Security grabbed me."

"Maybe you think that's all." The president struggled inwardly for a moment, and succeeded in changing his approving expression into a scowl. "What you haven't said is what the information was — how many of our secrets did you give away?"

"All of them — hold it — there's still no danger. Come on down to the lab, and you can look at every page of a copy we made."

The two men were silent as they walked the corridors and stood in the elevator. They both knew the talking would come soon enough. As they entered the lab, the president stopped and complained, "What a mess. I know what you've been doing here, and I still can't make head or tail of it."

Dr. Malvern smiled, for the first time since the interview had started. "And neither could any outsider who tried snooping. We have a good way of keeping security, even if it's by confusion. Now, the papers are in this safe. . . . 31 to the left . . . 41 right — and 59 left — here they are.

(*Continued on page 152*)

mineral policy

(*Continued from page 139*)

National Security and Well-Being
- Conservation
- Stability of Industry
- Cataloguing of Resources
- Stockpiling and Other Security Measures

International
- Access to Foreign Minerals
- Foreign Investment of Capital
  - Stability of Foreign Government
  - Restrictions on Ownership and Management
  - Restrictions on Production
  - Restrictions on Exchange
- Trade Relations.

The field of mineral policy has been framed in this simple way so that the interests of any country — whether it be the United States, Canada, Brazil, India or some other country — will tend to fit into the pattern, some countries, of course, less completely than others.

No attempt will be made in this outline to argue individual mineral problems. Some of the more controversial current problems, however, are here noted primarily because they inevitably come up in any discussion of mineral policy and it seems wise to relate them to the outline.

In the domestic field, there are the debatable questions of the extent to which public agencies should pursue exploration, the subsidizing of marginal production, and the development with public funds of processes for working and using low-grade resources, e.g., the obtaining of aluminum from clay, or oil from shale. Title to tide land oil is of current interest, as is the stock piling of mineral raw material.

From these few instances, it may be seen that an individual problem, though falling naturally into one of the group listings in the outline, may be related also to one or more other groups. Stockpiling, for instance, primarily a security measure, may also be related to conservation, the cataloguing of resources, and to the economics of individual industries. Though a domestic issue, stockpiles, by their very nature, will be drawn, in some part at least, from foreign sources and so will have an effect on foreign policy.

In the foreign field as in the domestic field, certain issues invariably are critical points of discussion — namely, access and capital investment. The term access is usually taken to mean entry into a country for the purpose of winning minerals; the "open door" on the one hand against the "closed door" on the other. Capital investment, largely private, calls for a look at the stability of the foreign government, its reliability in tenure of agreements, and its social attitudes.

Foreign mineral policy is but a part of a nation's overall foreign economic policy and international diplomacy. Though concerned only with minerals and mineral products, procurement from foreign sources, and particularly production by outside capital in foreign lands, cuts across so much of the foreign country's sovereignty and responsibility to its people as to make separation of mineral policy from other phases of foreign policy impossible. This same situation holds true for domestic mineral policy; mineral production is a business, subject in many of its relations to attitudes that cover all business regardless of product.

The accompanying map of world mineral production should be helpful in expanding the simplified policy outline projected in this article.

All this . . just for a Spring?

SURE . . . . mechanical spring design requires a firm grasp of fundamental facts and formulas. But there's a practical side, too, that often eases the way in many applications. When the time comes to apply your theory to actual work, remember Wallace Barnes as a friendly, helpful spring source — with a well-rounded knowledge of springs and springmaking that comes from long years of leadership in the field.

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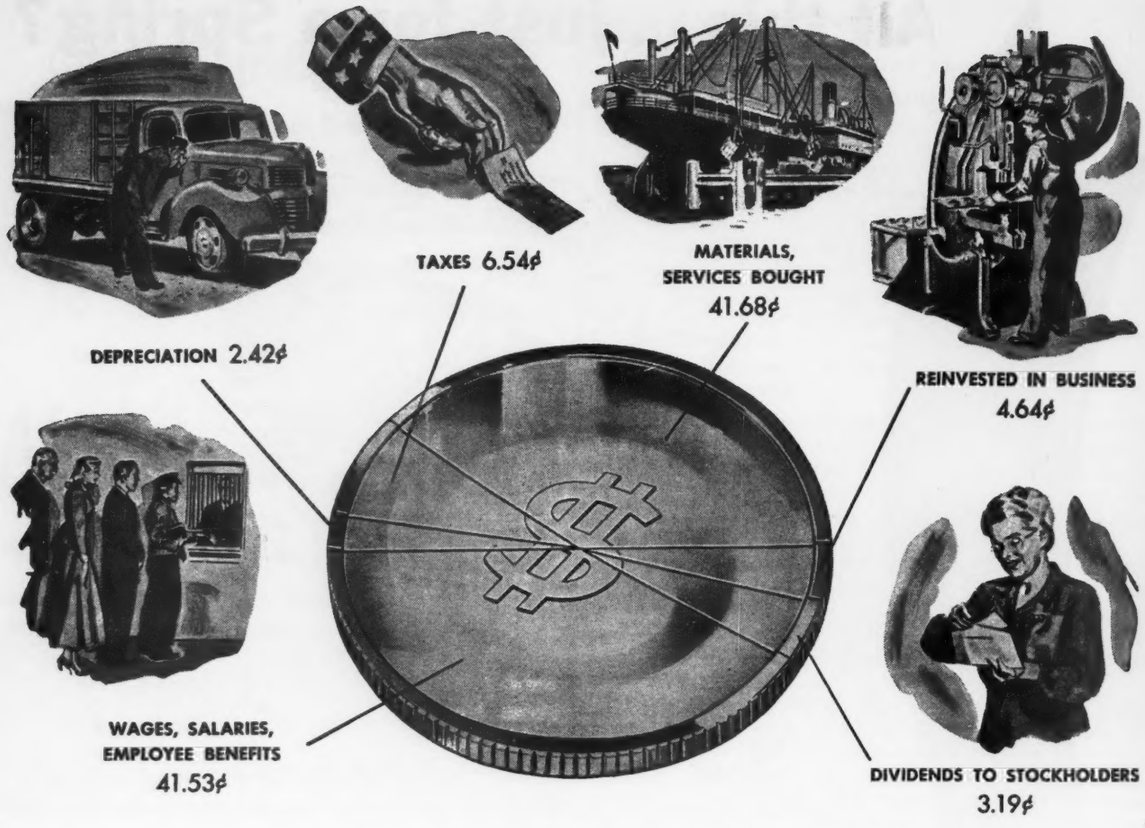

HOW TO DIVIDE UP A DOLLAR

. . . the American Way

It may interest you to know the mistaken notions most folks have about the profits of American companies.

They tell interviewers that they *think* such companies are entitled to make 12 to 15 cents on every dollar of income, as a fair return. Yet, they add, it's their guess that manufacturers *actually do* make about 25 cents!

The facts are that in normal years American companies average about *nine cents* profit per income dollar.

Take Aluminum Company of America in 1947, for example. Out of each dollar received last year by Alcoa and its subsidiaries, the net profit amounted to *less than eight cents*. We show above where the rest of that dollar went. Nearly half of it in wages, salaries, and employee benefits, to Alcoans. Almost another half for materials and services we bought. Over six and a half cents for taxes.

The dollars-and-cents story of Aluminum Company of America represents the kind of facts you'll get from any typical American enterprise. Facts that show a fair return for a good product.

By dividing up a dollar, the American way, Alcoa has provided secure employment for 46,000 aluminum workers and has helped America to gain world leadership in aluminum production and research.

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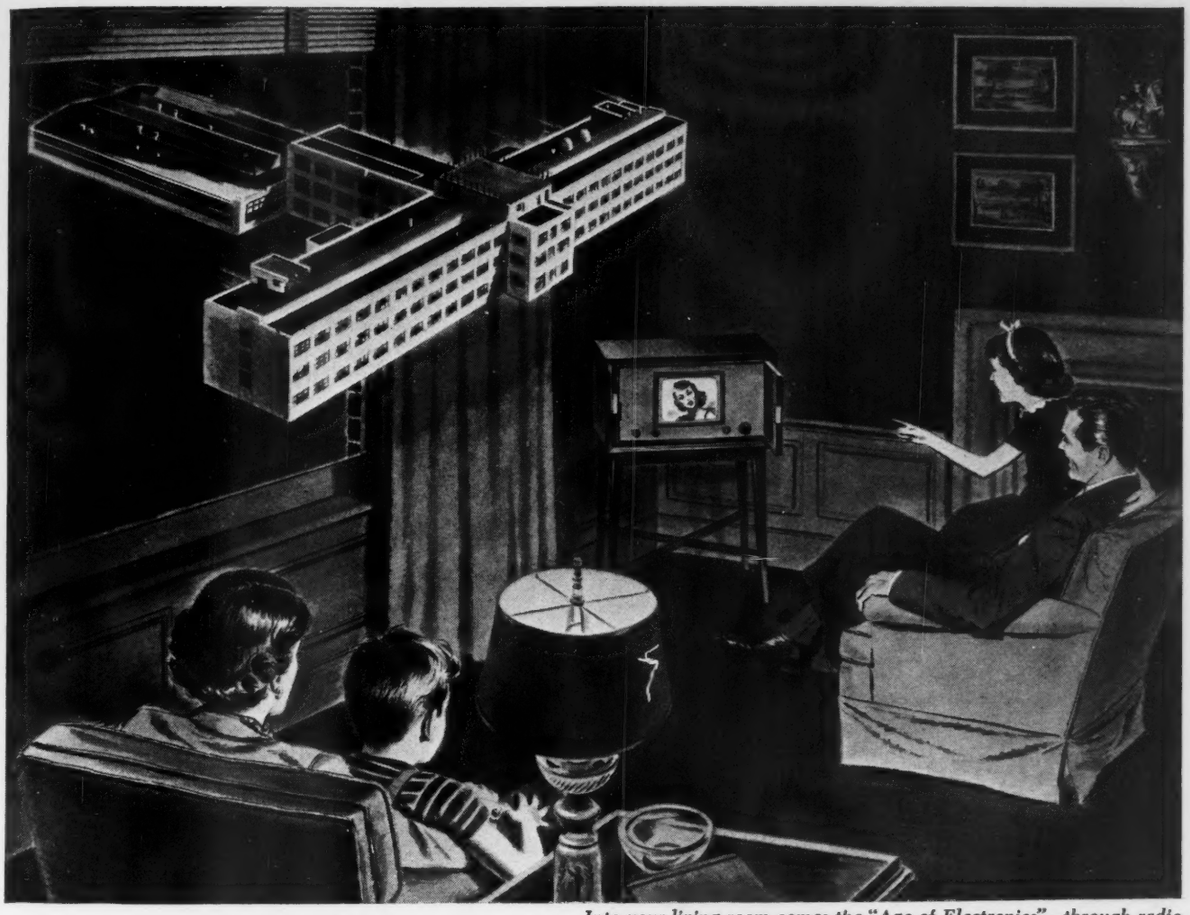

Into your living room comes the "Age of Electronics"—through radio and television research achievements of RCA Laboratories.

Research *comes to life in your Living Room*

Turn on your radio, tune in a television set—as simply as that you have completed the final step in a long chain of research and invention...

In a generous measure, your new command of *sound* and *sight* comes from research conducted at RCA Laboratories and made available for useful purposes. Almost every single major advance in radio and television during the past 30 years was pioneered by RCA.

A few examples of RCA leadership: all-electronic television, the all-electronic radio receiver, and the Victrola radio-phonograph. The iconoscope, television's electronic "eye," was developed by Dr. V. K. Zworykin—now of RCA Laboratories. Super-sensitive Image Orthicon television cameras and kinescope "picture tubes" for receiving sets and radio relays are RCA *firsts.*

Actually, these are just a few of the *hundreds* of examples of RCA leadership in radio and electronic research and engineering "know-how"... that give *value beyond price* in any product or service of RCA or RCA Victor.

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When in Radio City, New York, you are cordially invited to visit the radio, television and electronic wonders at RCA Exhibition Hall, 36 West 49th Street. Free admission. Radio Corporation of America, RCA Building, Radio City, N. Y. 20.

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- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
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- Design of receiving, power, cathode ray, gas and photo tubes.

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Also many opportunities for Mechanical and Chemical Engineers and Physicists.

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HIGGINS
Higgins non-tip rubber base keeps your Higgins American Waterproof India Ink upright. . . . Ask your dealer for both.
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271 NINTH ST., BROOKLYN 15, N. Y., U.S.A.

question mark, period

(*Continued from page 148*)

"The first of these is a directive to keep all these papers in absolute secrecy, subject to certain provisions. I had old Judge Lawson sign the agreement — he's been a justice since 1954, and his signature hasn't changed much since. The provisions specify that a single page should be released every five years until this year, 1989, when the remainder could be released. All the single pages were to be given to the newspapers under various false names, and the remainder were to be given up on July 22, 1989 (tomorrow!) to an individual proving himself to be John Malvern. If no claimant should appear before midnight, these too could be released, but only to the leading government research bureau. Finally it was certified that all information on those microfilms was there on or before July 21, 1959.

"Now for the pages. On each one I wrote a claim of successful prediction of a certain event — and that claim appeared after the event, so it could not influence the event. For instance, if one of the pages had read that the Democrats were going to win in 1968, and this came out ahead of the election, a lot of people might change their votes, and switch all subsequent events to a different track. But if the page is released in 1969, saying the Democrats will win in 1968, and Federal Legal can prove the paper was written ten years earlier — this is still significant, but cannot change the outcome.

"What is actually on the pages is very mixed, the election news, a few shreds of scientific research, the new models of the 1974 Chrysler, women's fashions, activities of the UN, and even some of the more interesting weather phenomena.

"The single pages don't mean much, though. The rest, which is to be delivered in one hunk, is a complete history of temporal transfer research and an explanation of the whole experiment.

"Here's the idea. The information may stay in this time-track, or may leave it at any time from '59 to now. That's why I have the single pages every five years — to check on when (if ever) it leaves our track. Also, there's the chance that even if the information is on a different track, something may be noticed on our track, since Jollard shows that adjacent tracks have a great many similarities. That's because even if you change your mind on something, most of the world won't be changed much. I can follow those five-yearly releases by looking up old newspaper files. If the information stays on our own time track, I will pick up my data tomorrow, and no information will have left the lab. If the information is on a different track, I won't be there to pick it up, and it will be publicly released — in a different world than ours, benefiting their temporal research program."

"Well, Dr. Malvern, I feel that though you have overstepped your

(*Continued on page 156*)

partners in creating

For 81 years, leaders of the engineering profession have made K & E products their partners in creating the technical achievements of our age. K & E instruments, drafting equipment and materials—such as the LEROY† Lettering equipment in the picture—have thus played a part in virtually every great engineering project in America.

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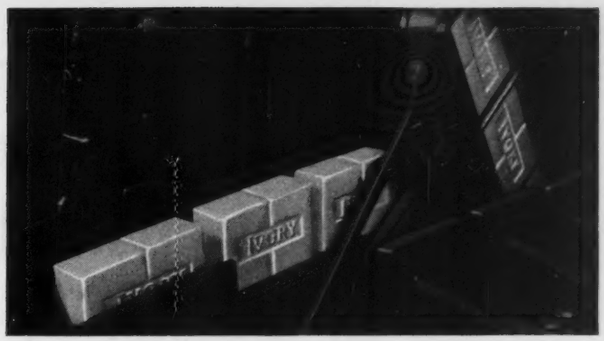
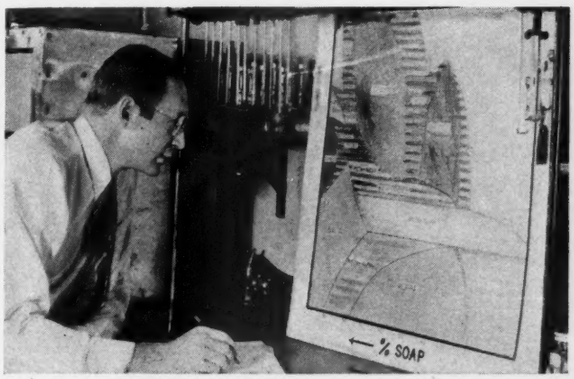
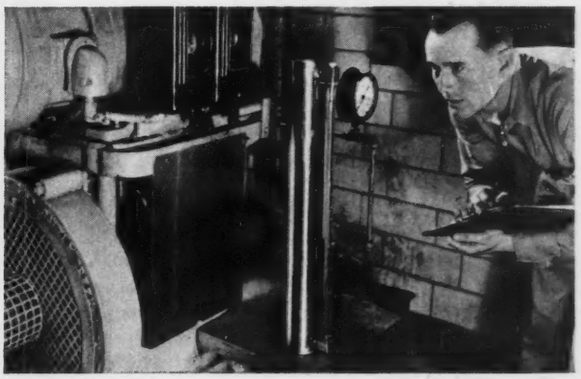


How close cooperation between chemists and engineers constantly improves this famous product

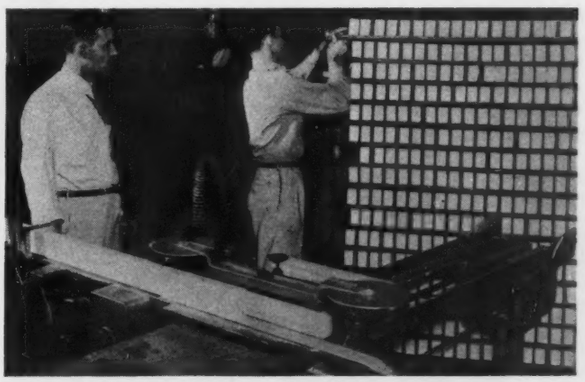


PHYSICAL CHEMISTS study the different phases of soap to define the conditions for improved Ivory bars.



CHEMICAL ENGINEERS make pilot plant studies like this flash drier, to translate these conditions into practical processing methods.

MECHANICAL ENGINEERS design equipment like this automatic vacuum "pickup" to improve methods of handling Ivory, and other soaps.



OTHER ENGINEERS (Chemical, Mechanical, Industrial) plan and supervise all phases of production operations.

This is just one example of P&G technical teamwork in action; similar developments in other fields call for additional men with technical training.

If you would like a copy of our booklet, "Information for Chemists and Engineers," write to Procter & Gamble, Industrial Relations Division, Cincinnati 17, Ohio. Also, if you'd like to talk to a P&G representative, ask your Placement Bureau to arrange a meeting.

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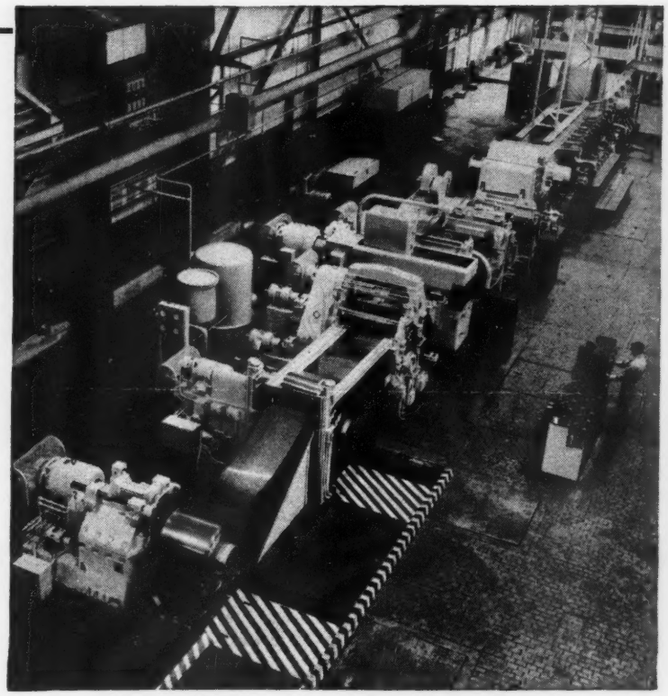
CINCINNATI 17, OHIO

Electrolytic tinning process stretches tin supply

—makes better, less expensive tin-plated products

•pioneered by Carnegie-Illinois Steel Corporation



▶ Before the war, almost all tin plate was made by the hot-dip method in which a sheet of steel was coated by dipping it into molten tin. In the 1930's, Carnegie-Illinois Steel Corporation, a member of the United States Steel family, played an important role in the research work and the technological development of the *electrolytic process*—an improved tinning method in which a strip of steel is given a thin, uniform coating of tin by passing continuously and rapidly through a bath of special plating solution. This process necessitated the development, by Carnegie-Illinois engineers, of complex mechanical equipment completely revolutionary in the industry.

Since the electrolytic process covers a given area of steel with only one-third the amount of tin that the hot-dip method requires, it makes the tin supply go 3 times as far.

Today, United States Steel Corporation has nine electrolytic tin-plating lines producing U·S·S Ferrostan. These lines are helping to lower the cost of tin-plated steel . . . stretch the supply of tin—and make better tin-plated products.

Opportunities

Work such as this has an important place in the operations of all U. S. Steel Subsidiaries. To be carried out successfully, these undertakings require qualified technical men. Why not see your Placement Officer about the book "Paths of Opportunity in U. S. Steel" and find out how you can take part in this interesting, important work?

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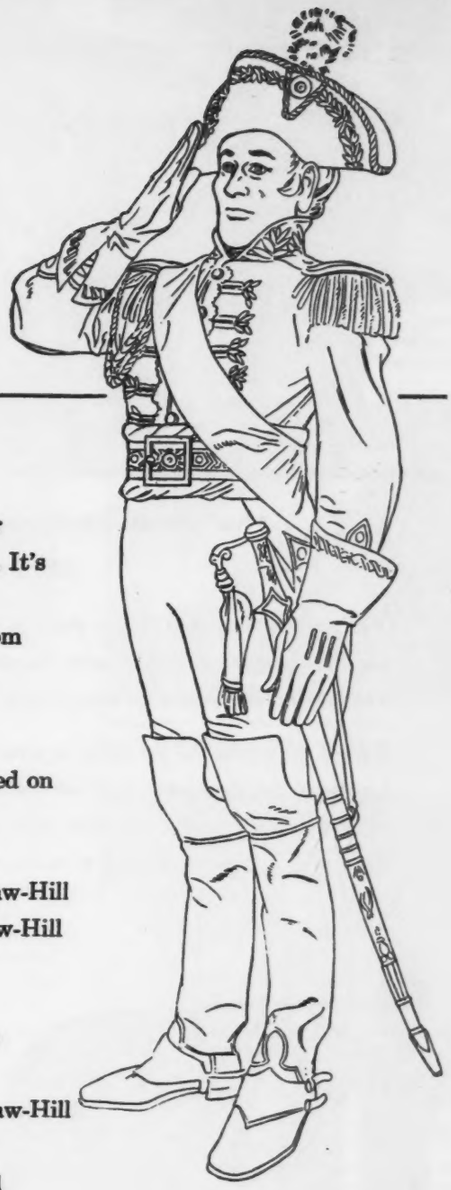
USS

UNITED STATES STEEL

"And What Are You Going To Do Tomorrow?"



. . . said one of Napoleon's generals to the young officer who was reporting on the victory he had won that day. It's a bit like that, too, in preparing for a career. The important thing is not only what you do in the classroom today, but what you are going to do tomorrow when you find yourself in the business world.

Tomorrow it will be as important to keep yourself posted on what's going on in your profession as it is to learn its fundamentals today. In the classroom you have been building much of that foundation probably with McGraw-Hill books. When you are in business, you will need McGraw-Hill books and magazines to help you keep forging ahead.

In both classroom and industry McGraw-Hill books are recognized as authoritative and standard works on their subjects. In business and professional fields McGraw-Hill magazines command the top editorial staffs, plus the world's largest news-gathering facilities devoted exclusively to business.

McGraw-Hill books and magazines should be your headquarters for technical information.

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. . . the tree became a newspaper through GRINDING!

WAY back in the woods Norton starts to have a part in producing your newspaper—axes and saws sharpened by Norton grinding wheels fell the trees and cut them to pulp wood lengths.

Then at the paper mill the wood is ground into pulp for newsprint by Norton Pulpstones—gigantic ten-ton, segmental grinding wheels as large as six feet in diameter and as wide as 66″—wheels developed by Norton research to replace nature's sandstones.

The machines that convert the pulp into paper and the complicated presses which print your newspaper contain many rolls and other parts precision-produced by Norton grinding machines and grinding wheels.

Norton Refractories are important, too—Alundum Laboratory Ware is used in the paper mill laboratories, Crystolon Brick in the power plants.

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LABELING MACHINES BEHR-MANNING DIVISION COATED ABRASIVES AND SHARPENING STONES

question mark, period

(*Continued from page 152*)

authority in making such an extensive experiment, the value of your contribution will compensate for any disadvantage. Since we must wait until tomorrow to see if Federal Legal has any papers for you, let's go to dinner. Afterwards, would you allow me to help you look for any newspaper item that will show if we stayed on the track?"

"Certainly, sir. Thank you."

* * *

PREDICTED JANUARY FLOODS, CLAIMS WRITER

New York, N. Y., July 22, 1964.

Today, in an absolutely unimpeachable statement, an unknown writer claimed he had predicted the exact time and extent of the floods that swept the Southeast this January. Richard Knewelyn, in an interview at the International Press offices, showed reporters a list of dates and flooded towns, together with notarized proof that the lists were filed approximately five years ago. He declined to make any further explanation. . . .

"That's the first assumed name, and they sure chose a fishy one. So far, so good — let's keep going!"

* * *

KNEW ELECTION OUTCOME TEN YEARS AGO

Boston, Mass., July 22, 1969.

Hugh Blackwen, of the Back Bay, proved that in 1959 he guessed correctly the outcome of last year's election. He had legal proof that ten years ago he filed a list of the number of votes gained by each of the seven presidential candidates in the 1968 campaign. He refused to comment on reporters' questions. . . .

"Number two. If this keeps up, I'll be sure the pages haven't disappeared onto another time-track."

* * *

CHRYSLER CORP. DENIES NEW-MODEL LEAK

Detroit, Mich., Aug. 1, 1974.

Chrysler Corporation denied unconditionally that any leak could have occurred fifteen years ago with respect to their recently released "Golden Anniversary" models. Walter deCamorra, spokesman for the firm, said that in all of the corporation's fifty years of automobile production, new models have never been designed more than eight years ahead. Furthermore, it would be impossible for anyone to deduce the design of the '74 models. Such was the claim reported in this paper last July 22, when we received from an anonymous source complete design plans for the 1974 Chrysler, together with proof backed by Federal Legal Corporation that the plans were drawn up over fifteen years ago. Mr. deCamorra said that Chrysler Corporation was planning an investigation. . . .

(*Continued on page 158*)

DU PONT Digest

For Students of Science and Engineering

The story of A CHEMICAL ACHIEVEMENT

How Du Pont scientists found a way to Moistureproof Cellophane

There's no secret to Du Pont's successful system for making chemical discoveries. It is simply research through teamwork.

As each new problem in research arises, it is tackled by men and women whose training and skill qualify them to master it. Backed by ample funds and facilities, they are continuously extending the field of scientific knowledge.

Take the case of moistureproof Cellophane. Plain, transparent Cellophane was strong, clear and protective. As a packaging material it had eye appeal. Its uses were limited, however. Perishable foods wrapped in this cellulose film were protected from contamination and were good to look at, but they did not retain their freshness. They either lost or absorbed moisture, depending on the nature of the food and atmospheric conditions.

That was a challenge to Du Pont research people. They set out to find materials that would moistureproof Cellophane without materially affecting its thinness or transparency. After developing a basic test to measure moistureproofness, they tried various procedures—adding ingredients to Cellophane dope before casting, impregnating sheets in baths and coating the film.

Dr. Hale Charch, *Ph.D., Ohio State '23, reenacts discovery of moistureproof Cellophane film. Bag at far right held water for weeks; other control bags showed evaporation.*

Coating showed the most promise. Had you been a member of the research team on this job, you might have helped mix and test several hundred different coating formulae over a 10 months' period. With successful coatings in sight, a small pilot operation was set up. Then—to make sure the new Cellophane was right—doughnuts, cookies and cakes were wrapped in it and sent to market. Finally, engineers were called on to design machinery for full-scale operation.

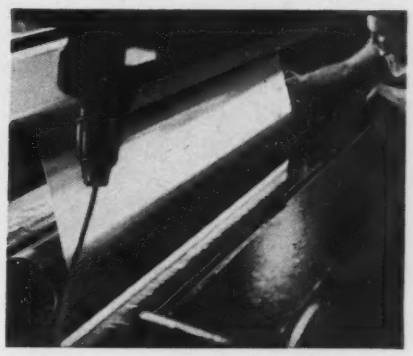
Now everything from chewing gum to porterhouse steaks is being sold in moistureproof Cellophane. Another scientific achievement is helping change the food packaging and food buying habits of America!

Using your training at Du Pont

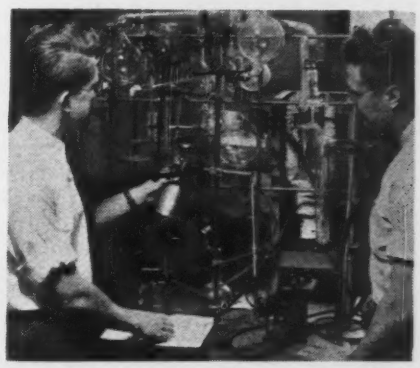
Diverse problems call for diversified talents. At any one time, there are hundreds of interesting projects under way in the Du Pont laboratories. You may be trained in chemistry, engineering or physics. You may have studied in the fields of botany, entomology, parisitology, pharmacology or plant pathology. In fact, almost all the sciences are put to use at Du Pont.

Working as a member of a small team, the individual is afforded every opportunity to show his talent and capabilities.

Cellophane has become *the nation's symbol for modern packaging. Since 1927, continuing research has developed over fifty different types.*



Cellophane is made *by extruding viscose through a slit into an acid bath where it coagulates into sheets. Moistureproofing follows.*



Organic Chemist M. L. Ward, *Ph.D., Illinois '42, and Physical Chemist P. E. Rouse, Jr., Ph.D., Illinois '41, conducting research on the permeability of thin membranes, including Cellophane.*

This is a booklet you shouldn't miss

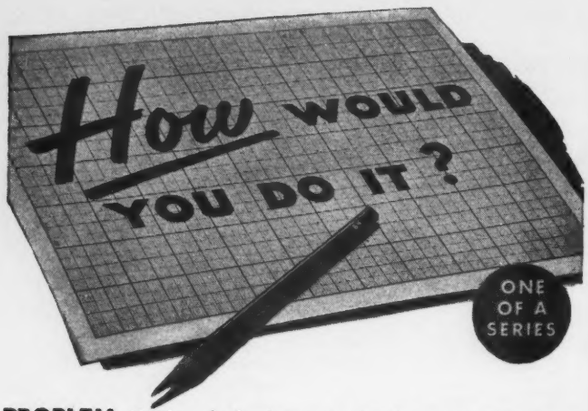
Before deciding on your first job, send for your free copy of "The Du Pont Company and the College Graduate." Describes opportunities for men and women with many types of training. Explains how individual ability is recognized and rewarded under the group system of operation. Address: 2518 Nemours Building, Wilmington 98, Delaware.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

More facts about Du Pont—Listen to "Cavalcade of America" Monday Nights, NBC Coast to Coast

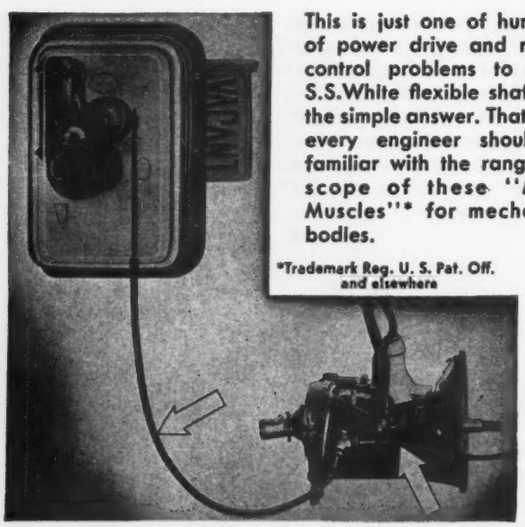
WRITE TODAY for "The Du Pont Company and the College Graduate"



PROBLEM—You're designing a taxi-cab meter. You have worked out the mechanism that clocks waiting time and mileage and totals the charges. Your problem now is to provide a drive for the meter from some operating part of the cab—bearing in mind that the meter must be located where the driver can read it and work the flag. How would you do it?

THE SIMPLE ANSWER—Use an S.S.White power drive flexible shaft. Connect one end to a take-off on the transmission and the other to the meter. It's as simple as that—a single mechanical element that is easy to install and will operate dependably regardless of vibration and tough usage. That's the way a leading taximeter manufacturer does it as shown below.

★ ★ ★



This is just one of hundreds of power drive and remote control problems to which S.S.White flexible shafts are the simple answer. That's why every engineer should be familiar with the range and scope of these "Metal Muscles"* for mechanical bodies.

*Trademark Reg. U. S. Pat. Off. and elsewhere

Photo Courtesy of Pittsburgh Taximeter Co., Pittsburgh, Pa.

WRITE FOR BULLETIN 4501

It gives essential facts and engineering data about flexible shafts and their application. A copy is yours for the asking. Write today.

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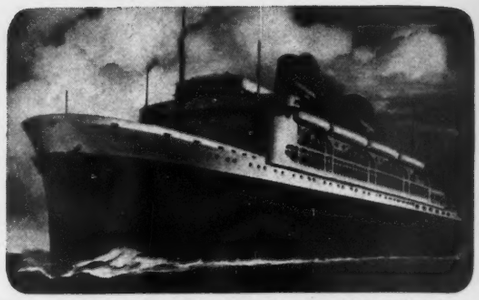
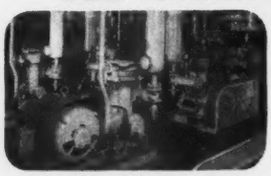


NEW "PRESIDENT" LINERS USE EIGHTEEN FRICK Refrigerating Machines



Four of Six Frick Refrigerating Units on the "President Cleveland"

And six of them are big ones, cooling nearly 110,000 cu. ft. of cargo space—including 1,200 tons of frozen food held at minus 10. The twelve other Frick machines cool twenty food service boxes for the 1,780 passengers and crew.

Three Large Frick Freon-12 Compressors on the "President Wilson"

Thousands of Frick Refrigerating machines are used on Navy vessels, liners, freighters, tankers, dredgers, yachts, tugs, and river boats. Equally dependable, afloat or ashore.

The Frick Graduate Training Course in Refrigeration and Air Conditioning, operated over 30 years, Offers a Career in a Growing Industry.

FRICK CO. WAYNESBORO, PENNA. U.S.A.

question mark, period

(*Continued from page 156*)

"That's bad. If they start getting curious, their action may turn things to another track. Dr. Malvern, do you think we can still be hopeful in spite of this?"

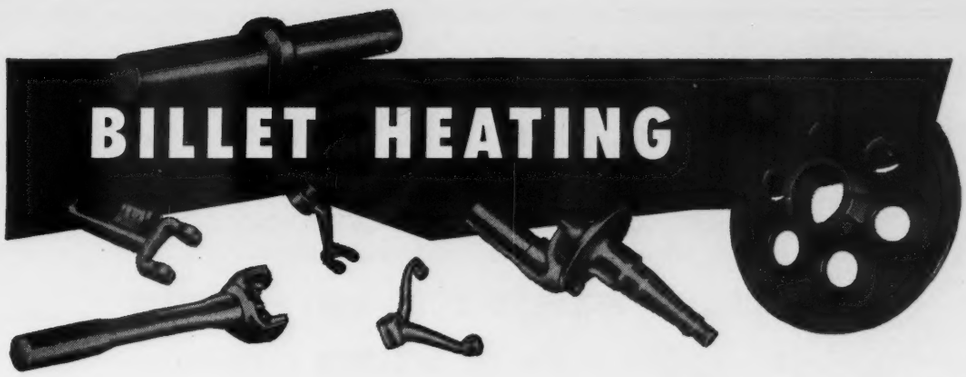
Dr. Malvern looked up from the automatic topic index in the City Periodical Library. "No, I'm afraid that our microfilm left the track between 1974 and '79 — probably because of Chrysler's investigation. I've been looking ahead, and there is no mention whatsoever of any prediction existing in 1979. Still, we were successful for over fifteen years. Now that there are no more news items, we may as well quit. I'll get to work on the results later and start cranking in the math."

"I still don't understand something. Didn't these articles we've been finding in the papers exist since the paper was printed, so that you could have looked them up before performing your experiment? It seems like a paradox."

"Certainly, the articles may have been here day before yesterday, but if I'd looked them up *then*, before the experiment, what I read might have influenced the experiment. It's the same reasoning I followed in having the 'predictions' occur *after* the event: similarly, I look up the results *after* I do the experiment."

"I'm somewhat confused, but you seem to be logical. Incidentally, to be logical means you shouldn't give up hope yet. The fact that there's no item in 1979 doesn't necessarily indicate leaving the track. The item might have gotten lost through carelessness or pressure of other news. At least, we should look for a news release in 1984."

(*Continued on page 164*)



Drop Forge Division Operations

WILLYS-OVERLAND MOTORS, INC.

Emphasize Speed of GAS

SPEED HEATING of small billets for drop forging demonstrates the speed of GAS for production-line operations requiring a flexible, controllable fuel.

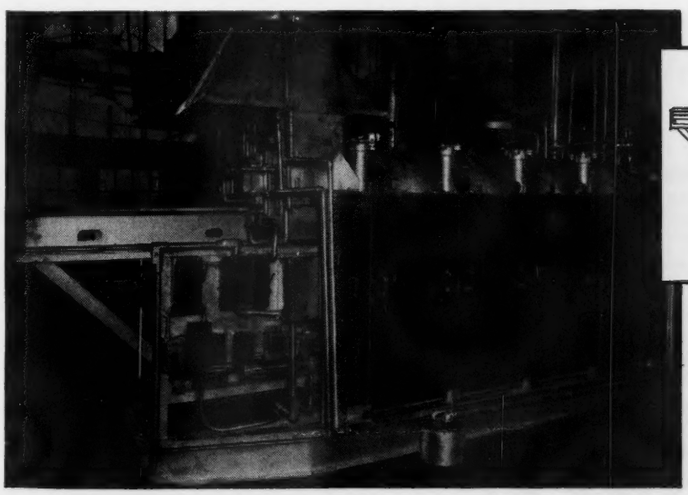
Drop Forge Division engineers and metallurgists, working with the furnace manufacturers, devised a simple Gas-fired, continuous-cycle billet furnace with the following characteristics and capabilities:

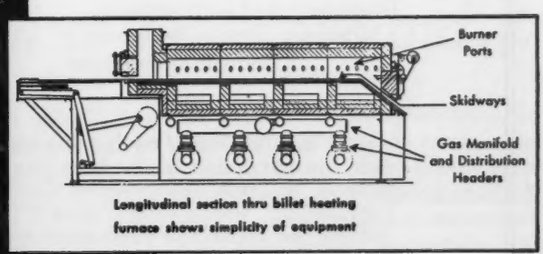
- **Billet Temperatures—2,200°-2,300°F**
- **Billet Heating Time—4 minutes normal (can be regulated as required in production schedules)**
- **Billet Discharge Rate—440 per hour, on 4-minute cycle**
- **Piece Dimensions (Average)—1"-2.5" thickness or diameter for rounds, squares, or flats up to 10" in length**
- **Furnace Heat-up Time—2,500°F in 15 minutes after initial lighting**

Quite as important as the productive capacity of the furnace are results of high-speed billet heating with GAS—

- **Uniform temperature of billets improves workability in forge**
- **Reduced scale minimizes abrasion in dies**
- **Flexibility for different sizes and shapes without costly equipment changes**
- **Economy of operation, of fuel costs, and of equipment investment**

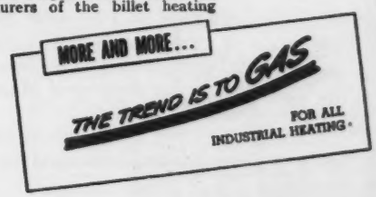
This application of modern Gas Equipment in an important production-line process is just one of the contributions made by GAS to industrial progress. There are many other heat-processing operations such as annealing, normalizing, stress-relieving, case-hardening, in which the productive flames of GAS have established records for productioneering. They're worth investigating.





Longitudinal section thru billet heating furnace shows simplicity of equipment

Section Drawing courtesy of Surface Combustion Corporation, Toledo, Ohio, manufacturers of the billet heating furnace.



AMERICAN GAS ASSOCIATION

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THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY
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  Options: Metallurgy
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Naval Architecture and Marine Engineering

The duration of each of the above undergraduate Courses is four academic years, with the exception of Architecture, Food Technology (Five Year Course), Physical Biology, and the Co-operative Courses in Electrical Engineering and in Mechanical Engineering, which extend over a period of five years. In addition to the Bachelor's degree, the above five year courses, with the exception of Architecture, lead also to the Master's degree.

Graduate study, leading to the Master's and Doctor's degrees, is offered in Ceramics and in most of the above professional Courses.

A five year Course is offered which combines study in Engineering or Science, and Economics. This leads to the degree of Bachelor of Science in the professional field, and to the degree of Master of Science in Economics and Engineering or Economics and Natural Science.

For information about admission, communicate with the Director of Admissions. The Catalogue for the academic year will be sent free on request.

Engineers review design of a new petroleum project. E. R. Wilkinson, L. S. U. '34; O. R. Menton, L. S. U. '38; W. A. Whitaker, Virginia '25; H. C. Leak, Mississippi State '43.

They're mighty good men to have around...

In times like these, engineers like the four shown here are mighty good men to have on the job at Esso Standard Oil—where our 28,000 workers today *average* almost 14 years with the company.

Their extra measure of skill, experience and job loyalty has set amazing records in *production* to help meet the high demand for gasoline and heating oil and other products.

One reason these extra-good workers are here today is simply the extra-good jobs they have at Esso Standard.

Over 30 years ago, the company set up an unusual "good jobs policy." It was based on the belief that better jobs would mean better workers, and that would mean a better company.

Since then, with our workers, we have developed plans which give every Esso Standard worker such job advantages as these: ***uniformly good wage scales... vacations with pay... special benefits in case of sickness or accidents... chance to advance in the company... cash savings in a Thrift Plan... fair treatment at all job levels... and planned retirement with steady income assured for life.***

All this was done as a matter of good business. It has given good business results. Not a strike or major work disturbance in over 30 years. Steady, skilful workers on the job. The development of new products from petroleum. New records in production to meet the country's needs. Yes... they're mighty good men to have around.

Esso

ESSO STANDARD OIL COMPANY

briefing the news

3,000,000,000 Electron Volts . . .

A synchrotron type sub-atomic accelerator capable of giving to protons energies of three Billion Electron Volts (B.E.V.) has recently been designed at Brookhaven National Laboratory. Three BEV is ten times the energy ever previously produced by any accelerator in the United States. It is expected that this "super-energy" accelerator will be in operation some time in 1950. It has already been approved by the A. E. C. The accelerator is to be called a "cosmotron" since it will be the first device to reproduce the primary particles of cosmic rays.

Design studies show that the cosmotron is capable of producing up to ten BEV but costs and time have dictated the lower energy of three BEV for the present project.

One of the men who designed the cosmotron is Dr. Stanley M. Livingston who is now working and teaching at M. I. T.

The cosmotron is really a large proton synchrotron. It makes use of both electric and magnetic fields. The magnetic field is used to hold the protons in a circular path. This is accomplished by a ring magnet between whose poles is a toroidal or doughnut-shaped vacuum chamber. The proton revolves through this chamber. Placed at one point on the circular path, an electric field gives the protons an added acceleration with every revolution. It is necessary for the electric field to be oscillatory and it must also be synchronized with the revolution of the protons. The frequency of the electric field increases continuously with the speed of the protons. An electrostatic generator is used to build up the energy of the protons to three MEV before they are injected into the cosmotron.

The proton-synchrotron type of accelerator was chosen above other possible types for this project because of various factors. First, magnetic accelerators such as betatrons were rejected because they have a practical energy limit of about one BEV. This was due mainly to radiation losses. Second, a linear accelerator could not be used because knowledge about them is insufficient at this time. Third, the synchrocyclotron was rejected because the solid core magnet it requires is excessively expensive.

Thus the best practical method to produce the desired energies of more than one BEV was with a ring-magnet proton-synchrotron.

New Ultrasensitive Emulsion ..

A new photographic emulsion for tracking down atomic particles has recently been developed by the Eastman Kodak Company. The new emulsion, about four times as fast as any previous product developed by this company, is so sensitive that Kodak is now faced with the problem of how to prevent premature exposure by cosmic rays during shipment to research workers. The intense barrage of these rays peppers the film so much that, unless adequately protected, it is clouded with background streaks upon development.

Packing the new material in dry ice may be a solution to the problem of partial premature exposure, since the product's sensitivity is reduced at low temperatures. On arrival it could be refrigerated and warmed up just before exposure.

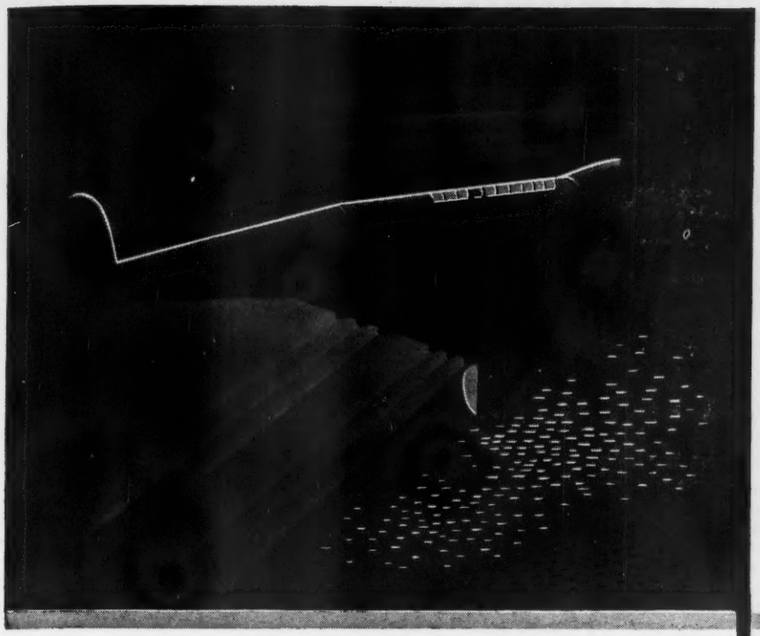
Dr. John Spence, in charge of the new emulsion, said that it "comes very close to complete recording of any nuclear particle." He also commented on the possible significance of the new film to autoradiography in medical research. In autoradiography, sections of tissue containing the radioactive isotope are placed in contact with the emulsion. The specimen takes its own picture when its own radiation exposes the emulsion.

Low Temperature Spectroscopy . . .

At room temperatures, various physical factors arising from the heat motion of molecules result in loss of detail in spectroscopy. This phenomenon, of course, limits the amount of information that can be gleaned from spectroscopic data, and especially the absorption spectra of complex molecules.

The possibility of obtaining clearer absorption spectra by cooling the samples in liquefied gases such as liquid nitrogen and hydrogen has been investigated by Professor John R. Loofbourow and his associates, Jesse F. Scott and Robert L. Sinsheimer. The new method is yielding results of unusual precision, and although, up to now, it has only been applied to biological materials, it may have advantages in other chemical fields as well.

Thin films of the biological materials are prepared on quartz slides, either by sublimation in a molecular still or by drying water solutions on the slides. The increased detail that the new method reveals may be a way of identifying specific compounds mixed with chemically inert materials.



Moving faster!

Efficiency in many mechanical devices is often a matter of high speeds and low weight. The resultant stresses make heavy demands on parts, whether they be in aircraft or automotive engines, machine tools or locomotives.

Molybdenum is the only alloying element that gives steel the two vital necessities for meeting such requirements—good hardenability and freedom from temper brittleness. Molybdenum steels will also meet the requirements of production economy.

Send for our comprehensive 400-page book, free; "MOLYBDENUM: STEELS, IRONS, ALLOYS."

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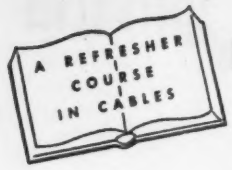
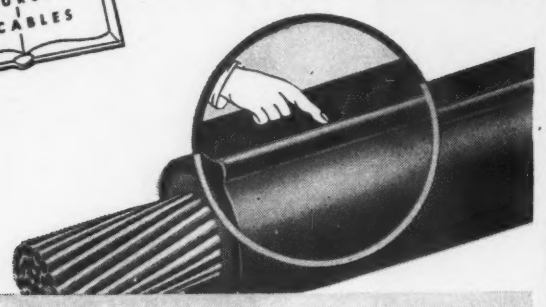


LOOK FOR THIS RIDGE



AND

YOU FIND A REASON

● There is more than mere identification value in the ridge you see on Okonite wires and cables. The ridge is proof that the insulation has been folded around the conductor by the well-known Okonite strip insulating process. This method permits inspection at all times during the application operation. It assures the perfect centering of conductors so important to the avoidance of electrical failures.

The ridge is a permanent mark of an Okonite cable. It is still prominent after the final vulcanization in a metal mold that insures equal transfer of the heat throughout every portion of the insulation. The Okonite Company, Passaic, New Jersey.

6965

OKONITE SINCE 1878

insulated wires and cables

question mark, period

(*Continued from page 158*)

"O.K. — we can look. But I don't expect anything. . . ."

* * *

PREDICTION MYSTERY PARTIALLY SOLVED

Washington, D. C., July 22, 1984.

The government announced today that it had found the common source of the "post facto" predictions that have appeared every five years since 1964. The Federal Legal Corporation two weeks ago admitted to a Congressional investigating committee that it had supplied all the predictions that have appeared under false names, but denied vigorously an allegation that any of the predictions originated later than 1959. The investigating committee claims that F. L. C. has refused the government permission to examine further papers in the series, except in the course of scheduled releases. The most recent release, cause of the government announcement, occurred today, when a microfilmed paper — proved, as were all the others, to have been filed in '59 — announced the new atomic rocket fuel which had been Top Secret up to last May.

The government also announced that it had suppressed a prediction appearing five years ago, which covered the UN's punitive action against the Argentine Empire. Congressman Lewitz (R., W. Va.) has called for legal action against F. L. C., but most independent attorneys feel that F. L. C. could not be forced to give up any information.

Still a mystery is how these things were known twenty-five years ago, and why the predictions are always released *after* the relevant effect. Scientists speculated this was to prevent undue profits from investments in "sure things." Apparently no further information will be forthcoming for five more years. . . .

"That caps it! They're on to the secret. In spite of all my precautions, that microfilm has produced a lot of influence. Nevertheless, it seems somehow to have stayed on the track. Tomorrow will tell us: is the microfilm on this track now — is it waiting for me at Federal Legal?"

Dr. Malvern dropped his head to the library table, but raised it suddenly when the college president spoke.

"Tomorrow? We can find out immediately. In all your work with 'time' you didn't notice we've been here all night looking up news articles. If we start now for the law offices, we ought to get there just before they open."

"The hell with that. First, I sleep. If Federal Legal really has the papers, they'll wait for me till midnight."

So sleep he did, until three that afternoon. By that time, the law offices were crowded with a growing and impatient audience. Government Security Police, reporters, a group of nervous scientists, and the customary mob of curiosity seekers were poorly restrained by the office staff. In one corner a Congressman was buttonholing a girl reporter: "They won't tell us who's supposed to come here or when. We have to wait all day without even learning what the damn microfilm enlargements say. I tell you it's obstructing the You Ess government — it's un-American, I say! We ought to arrest —"

At this point one of the police touched his arm, and whispered, "Senator — look — "

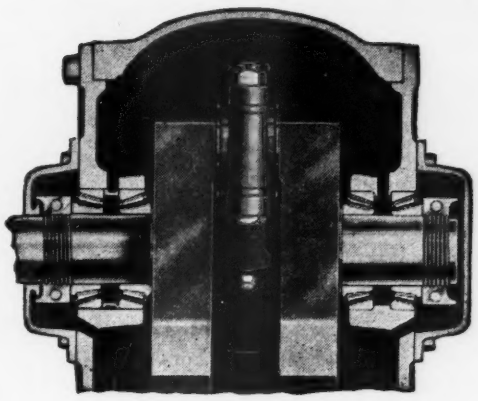
For John Malvern had entered and, unperturbed by the crowd, had asked if Federal Legal had some enlarged microfilm documents for him. The clerk examined his proffered identification card, and handed him a thick brown envelope. The crowd, led by the police, moved forward, then stopped as Dr. Malvern unsealed the envelope and looked at the contents. He appeared stunned for a moment, blindly handed the enlargements to the Institute's president, and sat down heavily. The assembly was silent. They wanted to know what was happening, but their questioning tongues were held by the knowledge that something was wrong. The president worriedly studied the first few pages and looked up, relieved.

"What's wrong, John? These say just the things you said you'd written, and everything is as it should be."

Dr. Malvern didn't raise his head. He spoke slowly, as if in solitude.

"Yes — the legal form is right, the context is right, and the words are the same as I wrote. But — the track has slipped somewhere. It's not my handwriting."

Another page for **YOUR BEARING NOTEBOOK**



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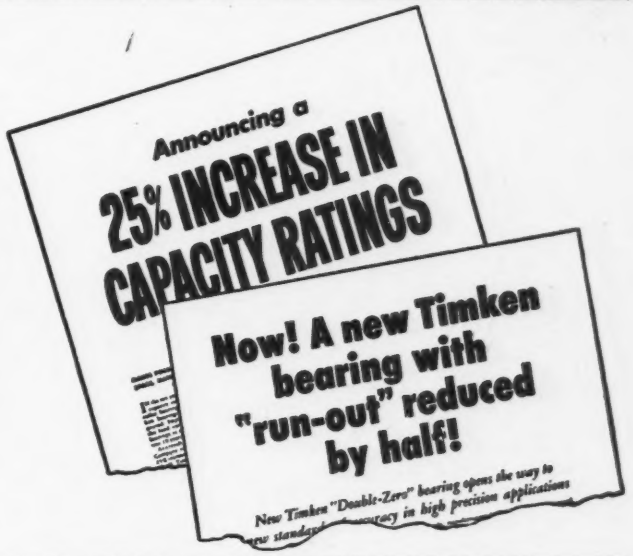
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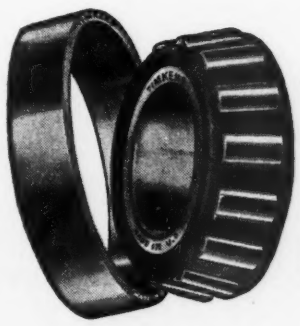

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